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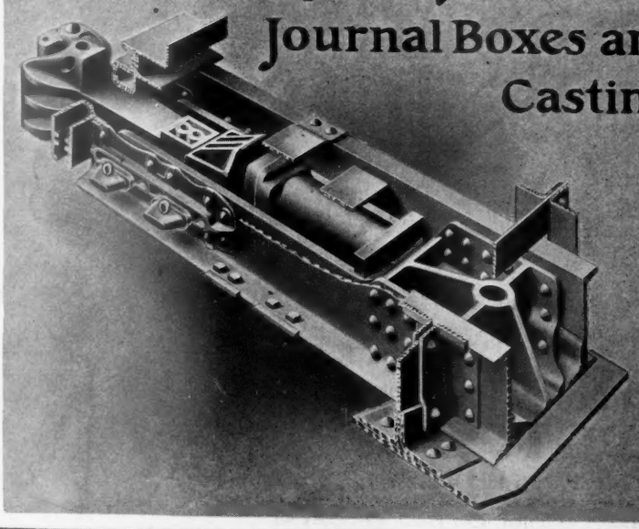

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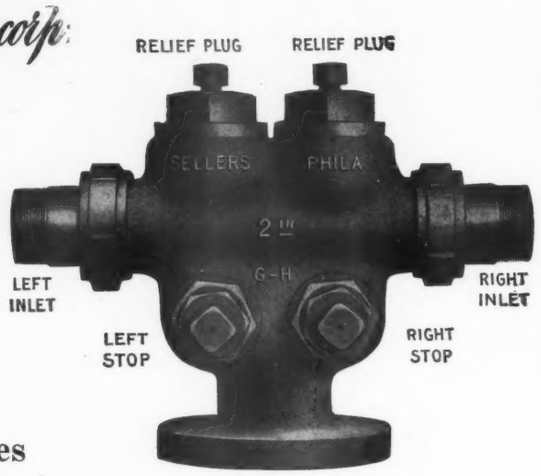

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Railway Mechanical Engineer

Volume 92 August, 1918 No. 8

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Have You an Objective?

The successful commander invariably selects an objective, then co-ordinates the forces at his disposal to attain it. So, in the winning of the war, our boys overseas (and in camp "over here") are part of a vast plan in which each of them is subject to rigid discipline, physical and moral. They are rationed in food and clothing and restricted to specified activities. We who stay at home are just as much a part of the forces on which our leaders rely and we must place ourselves under discipline, self-imposed, but no less rigid, so that each of us shall do all that we can to realize the final objective—not alone the winning of the war, but veritably making this world a fit place for free men to live.

Laudable efforts to economize, as a nation, in smaller groups and as individuals have oft-times resulted in "saving at the bung, wasting at the spigot," due to lack of co-ordination of forces. The first phase of our thrift campaign, with its sales of War Savings Stamps, and various food and fuel restrictive measures has given results not to be despised. But we can do more and must put our whole soul into the fight. Our armies need the best equipment that can be given them, and there being a scarcity of certain foodstuffs, materials, etc., it is our part of the fight to deny ourselves, so that those bearing the brunt of the battle may not fail because of our self-indulgence.

It is obvious that, while the ultimate objective of all is identical, the methods used to attain it must vary with our pursuits and station in life. Let each of us carefully appraise ourselves, select our immediate objective in the campaign of economy, take our place in the home battle line and do our duty in a way worthy of our heritage. To do this is our high privilege, to do less is treason.

Have an objective; strive to attain it!

Careless Switching and Its Effect on Car Repairs

The Southern regional director in a letter to the roads in his section states that reports to his office for the week ending May 4 show 7,625 cars damaged in yard switching service, while for the week ending June 1, the number had increased to 15,625. Observation indicates that much of this damage is needless. On the other hand the situation is difficult to control without carrying on an aggressive campaign of education so that each individual involved will be impressed with the necessity for using greater care and will fully realize his importance, as an individual, in the campaign to improve conditions.

The seriousness of the situation becomes apparent when this damage is translated into terms of the number of car repairmen that are required to remedy it. It is becoming more and more difficult to maintain the car repair forces and a determined effort must be made to reduce the damage to a minimum. It never was justified and is much less so in the present emergency. A sardonic grin would surely spread over the Kaiser's visage if he could see the contempt which some trainmen have for taking reasonable care of the equipment entrusted to their charge. The situation is all the worse when the damage to the lading is added to the cost of repairing the cars and the needless delays and loss in use of equipment. There are times when thoughtlessness or indifference can be overlooked, but today in the transportation

service it is a *crime*. Never were railway men better paid—even taking into consideration the increased cost of living; never were those in authority so solicitous as to the hours of service and comforts and conveniences of the employees; never was it so essential that each railway employee do his duty fully, carefully, thoroughly and cheerfully. What would happen if the boys on the other side performed their tasks in the spirit of some of those who are engaged in occupations in this country which are essential to our success in carrying on the war?

Keep up Betterment Work on Cars

The routing of cars irrespective of ownership has resulted in a marked increase in the number of cars off the tracks of the owning road and a corresponding increase in the number of cars of other roads that are undergoing repairs in car shops all over the country. This has caused considerable difficulty in keeping up the repairs to the equipment. While such trouble will be lessened somewhat now that the roads are permitted to use non-standard material wherever necessary to keep cars in service, this does not dispose of the important question of preventing wasteful repairing of weak parts. There are many obsolete cars now in service which the roads have planned to reinforce; the percentage on the home roads, however, is so small that the work is seriously hampered. It is impracticable to attempt to have foreign lines apply betterments to cars, so the weak parts are continued in service and replaced at frequent intervals.

It is important that the practice of repairing in kind parts of inadequate strength should be stopped, as it is a waste of both labor and material. Cars with short draft timbers especially should be reinforced. In planning the work the roads should take account of the small number of cars that are on the tracks of the owning line, and instead of trying to reinforce all the cars of a single class should plan to handle some of the cars in all classes that need strengthening. It is the usual policy to carry on betterment work at only a few of the larger shops. The application of metal draft arms does not demand special equipment, and this and other reinforcing work should be carried on at all points where it can be handled, in order that the maximum possible number of cars may be equipped. It would afford partial relief from the present conditions if the roads would arrange that whenever possible cars with short draft timbers should be sent under load to the owning line or a direct connection. If the car supply improves materially after the delivery of the equipment now on order it might even prove advisable to have such cars sent to the owning line empty.

Higher Sulphur and Phosphorus Limits for Steel

For several years the standard specifications for chemical analysis of steel products have remained practically unchanged. Conditions in the steel industry are now so critical that the allowable maximum contents of sulphur and phosphorus in many materials are being increased. For several months the steel manufacturers have experienced difficulty in complying with the chemical requirements of existing specifications due to the low grade of fuel available and the inability to obtain ore low in phosphorus. Under these conditions it was necessary to change the specifications or reduce the output of the mills. With steel in great demand, a decrease in the production would be very undesirable. Manufacturers have contended that slight increases in the sulphur and phosphorus content would not impair the physical properties of the steel and laboratory tests confirm this opinion.

In these circumstances, it seemed best to change the chemical requirements. The M. C. B. Committee on Specifications and Tests for Materials has already revised the specifications for structural steel, steel plate and steel sheets for passenger and freight cars, increasing the maximum permissible sulphur content from .05 to .06 per cent. The principal effect of sulphur in steel is to reduce the strength at high temperatures, and as these parts are usually worked cold the higher proportion does not seem objectionable.

It is probable that the specifications for other steel products used by the railroad will be changed also. The American Society for Testing Materials, which includes in its membership many representatives of the roads, has recommended that the sulphur limit on all steel and the phosphorus limit on acid steel be raised by .01 per cent in about forty specifications. Among the materials included are structural steel, bar steel for springs, carbon steel and alloy steel forgings, wrought steel wheels and tires, steel castings, boiler tubes and locomotive axles. Exceptions have been made in cases where the change might prove detrimental; for instance, the allowable sulphur content for car axles has not been increased and no revision was made in the chemical requirements for locomotive firebox, boiler, or boiler rivet steel.

The intent of the changes in these specifications is not to permit the manufacturers to include greater amounts of impurities in steel products, but rather to reduce the percentage of rejected materials during the war. Arrangements have been made for keeping a record of the service secured from material bought under the revised specifications. These statistics will serve to show whether the higher sulphur and phosphorus contents prove detrimental to the material under actual service conditions and should furnish valuable information on which to base future specifications.

Railroad Conditions in Germany

The condition of the railroads in Germany has a direct effect on the military strength of the country and for that reason is of considerable importance to the United States and her Allies. Of the many conflicting accounts reaching us from the Central Powers it is hard to judge which are true and which are false reports disseminated for the purpose of creating the impression that Germany is on the verge of a breakdown and thus slowing up the military program of the Allies.

This country has seen the tremendous burden which war puts on the transportation system. Undoubtedly the German railroads have their troubles as well. We hear that there is difficulty in getting enough coal, that the supply of skilled labor is inadequate and that locomotives and cars cannot be kept in repair. The allied airmen have added to these troubles by frequently dropping bombs on important railroad centers. It seems quite certain that these difficulties really exist. However, the majority of people find it very easy to believe reports which picture conditions as they desire them to be, and it is highly probable that many of the reports of a breakdown of the German railways that have been circulated in this country are part of the German propaganda. Consider, for example, the reports published repeatedly during the past two years that the proper lubricants for railroad equipment could not be secured in Germany, and as a result locomotives needed frequent heavy repairs and train delays were greatly increased due to the prevalence of hotboxes. According to the testimony of Americans who were in Germany up to the time when this country entered the war, the shortage of lubricants at that time had scarcely affected even the non-essential industries. It is improbable that such plants would be allowed to use any oil if the railroads were not assured of an ample supply. Since then the Germans have had an opportunity to rebuild the refining plants in the Roumanian oil fields, yet reports of the shortage of lubricants continue.

There are many indications that German rolling stock is not in such bad condition as has been represented. While no operating statistics are available we know that the receipts of the German railways for the first nine months of 1917 exceeded those for the corresponding period of 1916 by 30 per cent on passenger traffic and 5 per cent on freight. Before the war Germany did a large export business in railroad supplies of all kinds, and that the plants she possesses are capable of taking care of the requirements of the German railway system seems evident from the fact that the Germans are now building two railways in Finland and have started deliveries on 30 locomotives and a considerable tonnage of rails ordered by the railroads of Sweden. The only logical conclusion that can be drawn from these facts is that there is little prospect of a breakdown of the German industrial system. We must win by force of arms. Every railroad man in this country should realize that by doing his work well he will help to speed the day of victory for the United States and her Allies.

The Steam Consumption of Auxiliaries

Few railroad men realize the large proportion of steam generated on a locomotive that is used by the auxiliaries. In freight service the steam supplied to the air compressor alone is often as much as ten per cent of that which goes to the cylinders. Add to this the steam used by the headlight and the blower and that wasted through the safety valve and by steam leaks at valve stems and piston rods and the total will amount to as much as fifteen per cent of the steam used in pulling the train. In passenger service the amount of steam used by the air compressor is not as great, proportionately, as in freight service, but during the winter the steam used to heat the cars brings the percentage used elsewhere than in the cylinders to a high figure, often over twenty per cent.

While great care is taken to prevent losses in the valves and cylinders, little attention is paid to the condition of the numerous devices on the locomotive that are constantly using steam. The air compressor is subjected to more abuse than any other machine of equal importance. Compressors with efficient strainers and proper lubricating devices are the exceptions rather than the rule. It is unreasonable to expect an appliance that is given so little attention to use steam economically. The safety valves are a part of the locomotive equipment that most railroad men consider should go from one shopping to another without attention. Very often such a record is made, but how much fuel is wasted through safety valves that start to leak five or ten pounds below the pressure for which they are set, or that when once open continue to blow out a small amount of steam until the pressure has fallen considerably below the point at which they should seat. Such defects should receive prompt attention, but there is always a tendency to regard them as scarcely worthy of notice.

To appreciate the effect of a saving in the steam used by the auxiliaries the resulting increase in hauling capacity should be considered. Only fifty to sixty-five per cent of the power developed in the cylinders is delivered at the drawbar under ordinary conditions. Thus, if the steam saved by these minor economies amounts to five per cent of that used by the cylinders, instead of adding five per cent to the hauling capacity it will increase the capacity nearly ten per cent. Similarly if the saving is not utilized in hauling greater tonnage it will reduce the amount of coal burned and lower the rate of combustion, and this in turn will decrease the coal consumption per pound of water evaporated, resulting in cumulative savings.

The importance of economy in the use of fuel has been emphasized during the past year as it never has been before. No saving is too great to strive for and none too small to deserve consideration. A great deal of attention is being paid to the economical generation of steam in the boiler and its utilization in the cylinders, and rightly so. It is here, beyond a doubt, that the greatest field for economy lies. However, the steam consumed by the auxiliaries is by no means a negligible amount and it should also be given its share of attention.

NEW BOOKS

Fuel Economy in the Operation of Hand Fired Power Plants. Edited by the research staff of the Engineering Experiment Station of the University of Illinois. Illustrated, 90 pages, 6 in. by 9 in. Bound in paper. Published by the Engineering Experiment Station of the University of Illinois, Urbana, Ill.

The average small power plant is an inefficient unit and can save 15 per cent of its fuel by the exercise of greater care in equipment and operation. To show how this is possible the Engineering Experiment Station of the University of Illinois has issued Circular No. 7, entitled Fuel Economy in the Operation of Hand Fired Power Plants. It presents to managers, superintendents, engineers and firemen suggestions that will help them in determining the properties and characteristics of the coal purchased and in effecting greater economy in its use. The features of installation essential to the proper combustion of fuel are discussed, the practice to be observed in the operation of the plant is outlined, and the employment of simple devices for indicating conditions of operation is described. A limited supply of copies of this publication is available for free distribution.

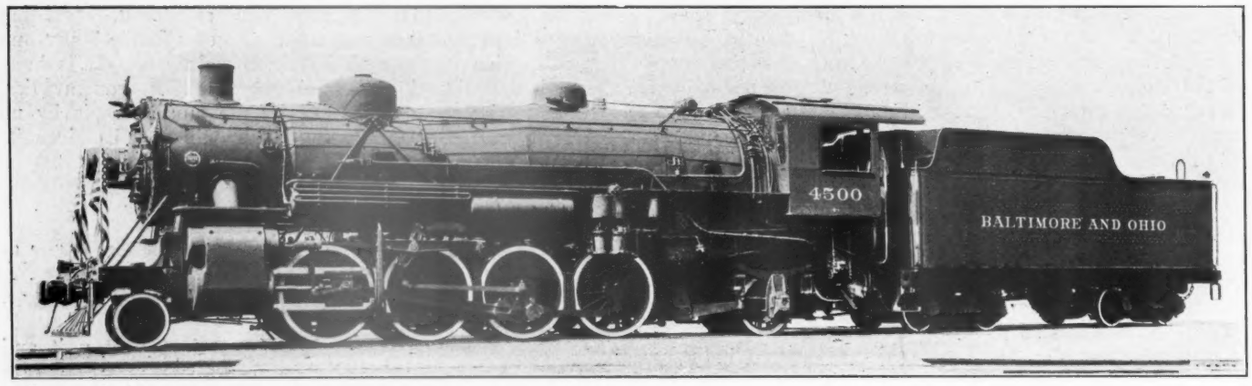
The Cost of Power. By Gerald B. Gould, M.A., and Carleton W. Hubbard, B.S. 125 pages, 4½ in. by 6½ in., illustrated, bound in leather, published by the Fuel Engineering Company of New York. Price $2.

This manual was originally written for private distribution among about 200 manufacturers and is the result of their co-operative efforts to eliminate guesswork methods in the selection and purchase of coal, and the development of power. By comparing the combined experience of these coal users in the purchase and use of nearly $50,000,000 worth of coal, the attempt is made to reduce the problem to basic principles. All of the plans and theories advanced have been tested in actual use, and each fact given has been verified by a large number of observations. In the form presented the book has been planned to fill the need of business men who have not had an opportunity to study the broader aspects of heat and power problems; its object is to supplement the reader's knowledge with a detailed analysis of the experience of many users of coal and makers of power.

Proceedings of the International Railway General Foremen's Association. 104 pages, illustrated, 6 in. by 9 in., bound in paper. Published by the association, William Hall, secretary, 1061 West Wabash avenue, Winona, Minn.

Although the General Foremen's Association held no convention in 1917, a successful effort was made to give the members of the association as much benefit from the organization as possible. The pre-determined papers and reports were written and advance copies were sent to the members. The official proceedings contains these papers, together with many written discussions on them submitted by various members of the association. The important subjects discussed include Engine Failures, Causes and Responsibilities, Methods of Meeting the Requirements of Federal Inspection Laws, Alinement of Locomotive Parts to Give Maximum Service with Minimum Wear, and What Interest Has the Locomotive Foremen with Car Department Matters.

The association is to be congratulated upon the fact that even though no convention was held, the members of the association have received something that will be of assistance to them in their work.



First Standard Locomotive to Be Completed for the Railroad Administration

FIRST U. S. STANDARD LOCOMOTIVE

Light Mikado Type Built by the Baldwin Locomotive Works, in Service on the Baltimore & Ohio

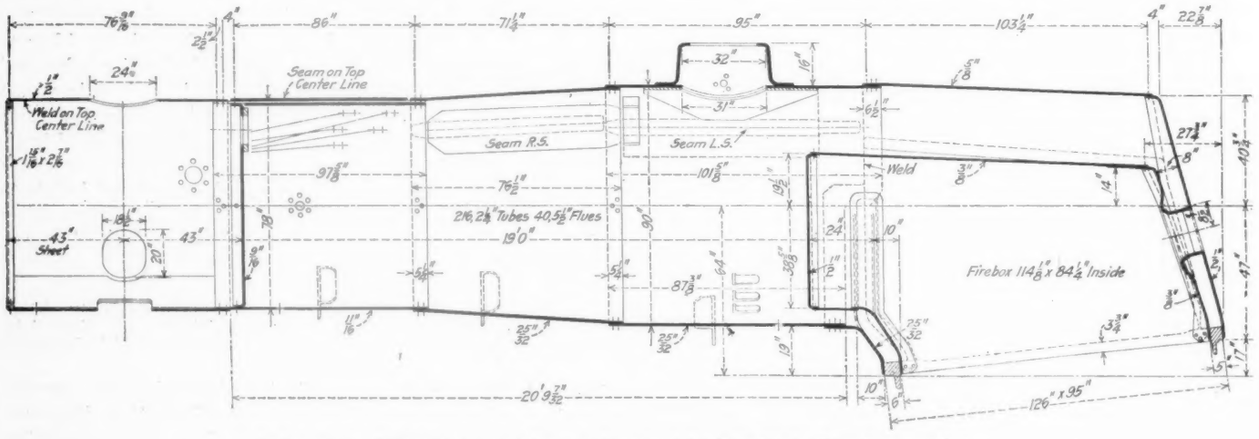
THE first locomotive of the Railroad Administration's order of standard locomotives placed with the builders on April 30, was completed on July 1, by the Baldwin Locomotive Works. This locomotive is of the light Mikado type, the specifications for which call for 55,000-lb. driving axle loads, and has been placed in service on the Baltimore & Ohio.

The orders for standard locomotives first placed by the Railroad Administration totaled 1,025. Later orders for 390 locomotives brought the total up to 1,415, of which 575 are light Mikados. This is by far the largest number of any type ordered; the next largest group is the heavy Mikado type, of which 157 are to be built.

The design of the light Mikado type locomotive is straightforward throughout, with nothing of an unusual nature either in the general design or the details of construction. The locomotive has a total weight of 290,800 lb., of which 221,500 lb. are on the drivers, and it exerts a starting tractive effort of 54,600 lb.

The boiler is of the conical wagon top type, 78 in. in diameter over the first course and increasing to 90 in. in outside diameter at the dome course. The longitudinal seam of the dome course is on the left hand side of the center line, and the reinforcing pad on the inside of the shell under the dome is extended to form the inside welt strip of this seam. The longitudinal seams of the conical and front courses are at the right and on the top center line of the boiler, respectively. These seams are all welded at the ends.

On the basis of Cole's ratios, the boiler capacity rating is practically 96 per cent of the cylinder requirements in respect to the heating surfaces, and slightly over 100 per cent in respect to the grate area. The tubes are 2¼ in. in diameter and 19 ft. long over the tube sheet, the ratio of the diameter to the length of tubes being about one to 100. The firebox includes a combustion chamber 24 in. long and is

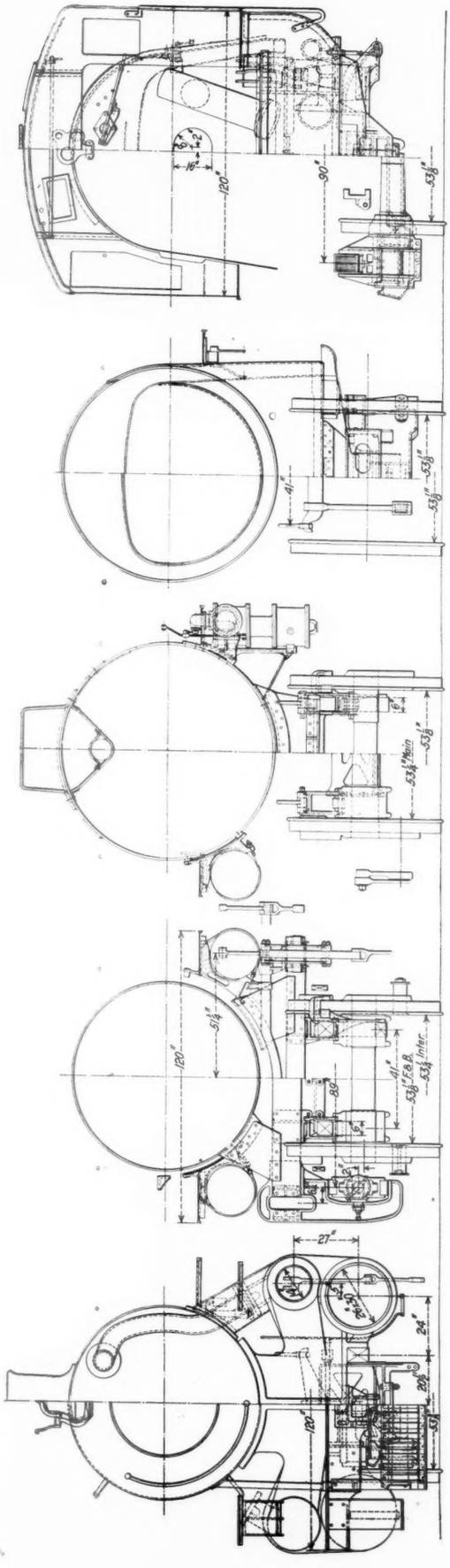


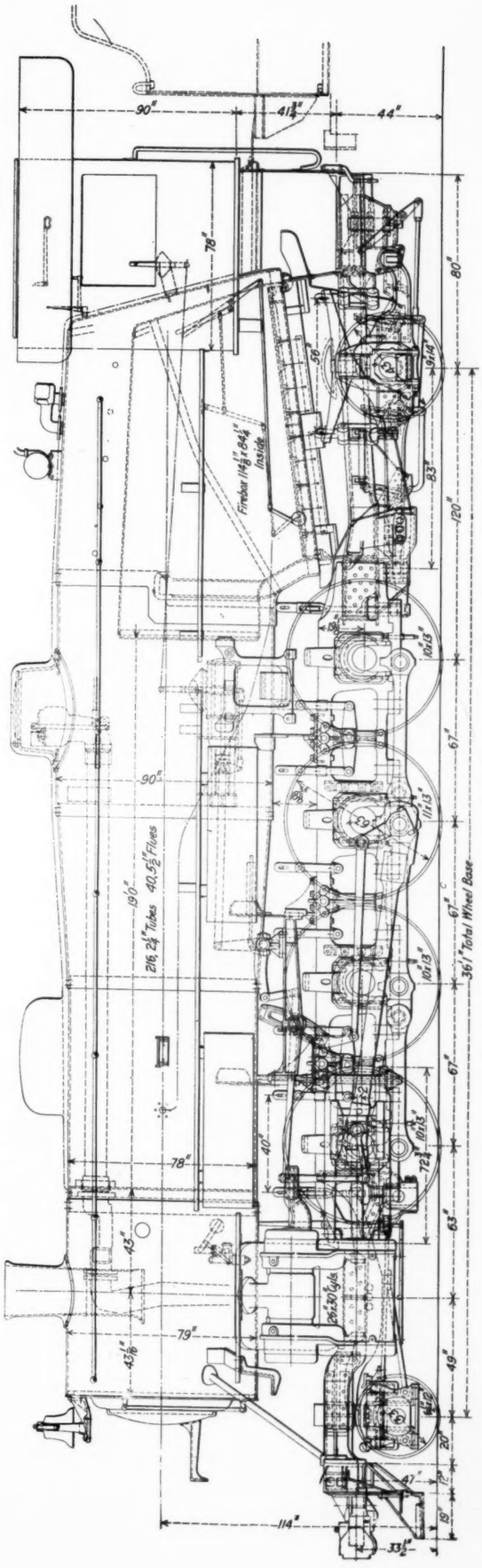
Boiler of the Railroad Administration Standard Light Mikado Type Locomotive

fitted with a Security arch. The boiler includes the Locomotive Superheater Company's Type A superheater with 40 units and is fired by a Duplex stoker. It is fitted with a Shoemaker fire-door.

The ash pan has three center hoppers with swinging drop bottoms. The opening under the mud ring is 5½ in. wide. The grates are operated by a Franklin grate shaker.

The frames are of cast steel, 6 in. wide, with a single integral front rail. The top rail is 6⅝ in. deep over the pedestal and is 5⅝ in. deep at the smallest section. The depth of the lower rails at the smallest section is 4 in. The taper of the pedestal jaws and binder lugs is one in twelve. The front rail under the cylinders is 9⅞ in. deep and the



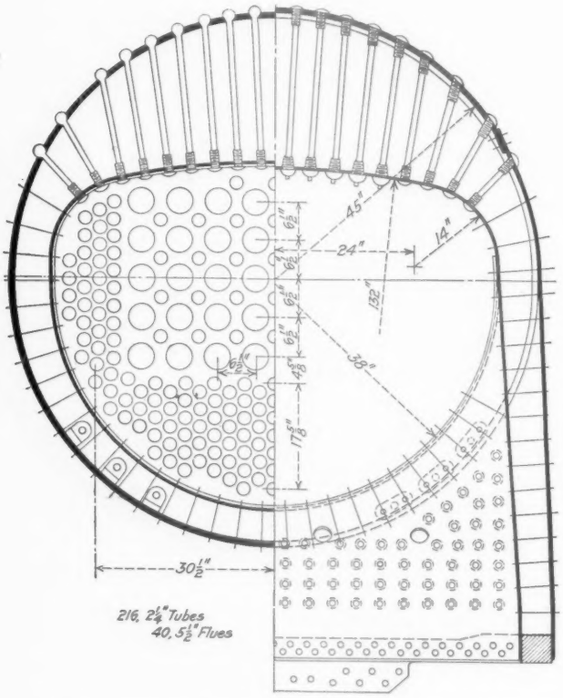


Elevation and Cross Sections of the Railroad Administration Standard Light Mikado Type Locomotive

section is reduced to 3½ in. wide by 10 in. deep where the front deck plate is attached. The trailer frames are cast in one piece with the trailer fulcrum pin bracket, the equalizer brackets and the rear deck plate. This casting is attached to the main frames with fourteen 1¼-in. bolts on each side. The pedestal binders are of the usual type, each held in place by four 1½-in. bolts.

Vertical cast steel frame cross-ties are applied to the front legs of the forward driving-wheel pedestals and to the rear legs of the second and third pedestals. The forward brace includes an extension at the bottom, which is bolted to the lower frame rails just behind the cylinders. This carries the pivot for the front engine truck and the driving brake lever fulcrums. The top rails are further secured by cast-steel deck braces, which extend across the frames between the first and second, and the third and fourth pairs of driving wheels.

The cylinders and valve chambers are fitted with gun-iron bushings. The pistons are steel of single plate dished section. The piston valves are of the built up type, with a cast-iron body, fitted with gun-iron bull rings and packing rings and cast-steel followers. King type packing is used in the piston rod and valve stem glands. The crossheads have cast-steel bodies, to which are bolted Hunt-Spiller gun-iron wearing shoes. Steam distribution is controlled by the



Sections Through the Firebox and Combustion Chamber

Walschaert valve gear, to which is fitted a Ragonnet power reverse gear.

Cast-steel driving boxes, fitted with Elvin grease cellars, are used throughout, all having journal bearings 13 in. in length. The journals on the main axle are 11 in. in diameter, while the others are 10 in. in diameter. The driving wheels are fitted with brass hub liners.

The leading truck is of the Economy constant resistance type and the Hodges trailing truck is used.

The tender has a Commonwealth steel frame. The frame casting includes the front drawbar pocket and the rear draft sills, as well as the truck center plates. The tank is of the usual type of construction, the corners being formed by 2½-in. by 2½-in. angles. The bottom and top plates are 5/16 in. in thickness, while the sides and ends are ¼ in. thick. The tank manhole is 18 in. wide by 8 ft. in length across the tank. This great length materially facilitates spotting of the locomotive at water plugs.

The tender is carried on four-wheel trucks with cast-steel side frames and bolsters fitted with elliptic springs. The wheels are rolled steel, 33 in. in diameter and are mounted on axles having 6-in. by 11-in. journals.

The specialties include Everlasting blow-off valves, 2-in. Consolidated safety valves, Ashcroft gages, 1¼-in. Barco blower valve fitting, Nathan non-lifting injectors, Franklin ball joints and Radial buffer and Unit safety bar between the engine and tender.

The principal data and dimensions follow:

General Data

Gage	4 ft. 8½ in.
Service	Freight
Fuel	Bit. coal
Tractive effort	54,600 lb.
Weight in working order	290,800 lb.
Weight on drivers	221,500 lb.
Weight on leading truck	20,200 lb.
Weight on trailing truck	49,100 lb.
Weight of engine and tender in working order, approx.	462,800 lb.
Wheel base, driving	16 ft. 9 in.
Wheel base, total	36 ft. 1 in.
Wheel base, engine and tender	71 ft. 4½ in.

Ratios

Weight on drivers ÷ tractive effort	4.0
Total weight ÷ tractive effort	5.3
Tractive effort × diam. drivers ÷ equivalent heating surface*	730.9
Equivalent heating surface* ÷ grate area	70.6
Firebox heating surface ÷ equivalent heating surface,* per cent	6.1
Weight on drivers ÷ equivalent heating surface*	47.0
Total weight ÷ equivalent heating surface*	61.8
Volume both cylinders	18.4 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	255.3
Grate area ÷ vol. cylinders	3.6

Cylinders

Kind	Simple
Diameter and stroke	26 in. by 30 in.

Valves

Kind	Piston
Diameter	14 in.
Greatest travel	7 in.
Steam lap	1⅛ in.
Exhaust clearance	0 in.
Lead	3/16 in.

Wheels

Driving, diameter over tires	63 in.
Driving, thickness of tires	3½ in.
Driving journals, main, diameter and length	11 in. by 13 in.
Driving journals, others, diameter and length	10 in. by 13 in.
Engine truck wheels, diameter	33 in.
Engine truck, journals	6½ in. by 12 in.
Trailing truck wheels, diameter	43 in.
Trailing truck, journals	9 in. by 14 in.

Boiler

Style	Conical wagon-top
Working pressure	200 lb. per sq. in.
Outside diameter of first ring	78 in.
Firebox, length and width	114⅛ in. by 84¼ in.
Firebox plates, thickness	Tube, ½ in.; crown, sides and back, ⅜ in.
Firebox, water space	Front, 6 in.; sides and back, 5 in.
Tubes, number and outside diameter	216—2¼ in.
Flues, number and outside diameter	40—5½ in.
Tubes and flues, length	19 ft.
Heating surface, tubes and flues	3,497 sq. ft.
Heating surface, firebox, including arch tubes	286 sq. ft.
Heating surface, total	3,783 sq. ft.
Superheater heating surface	882 sq. ft.
Equivalent heating surface*	4,706 sq. ft.
Grate area	66.7 sq. ft.

Tender

Tank	Water bottom
Frame	Cast steel
Weight, approximate	172,000 lb.
Wheels, diameter	33 in.
Journals, diameter and length	6 in. by 11 in.
Water capacity	10,000 gal.
Coal capacity	16 tons

* Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

ELECTRIC LOCOMOTIVES BUILT IN SOUTH MANCHURIA.—The 50-ton electric locomotives for use by the Fushun collieries are the first built at the South Manchuria Railroad shops. They are of standard gage. Each is designed to haul 580-ton trains at a speed of 12.9 miles per hour, on the level, straight track, exclusive of the locomotive. The trolley voltage is 1,200. They are of the two-bogie type, each bogie carrying a 125-hp. motor.

DRAFTING MODERN LOCOMOTIVES

N. & W. Tests; a Comparison of the Best Results with the Various Nozzle and Stack Arrangements

BY H. W. CODDINGTON
Engineer of Tests, Norfolk & Western, Roanoke, Va.

PART III*

THE results obtained from the annular nozzles constructed on a 14-in. diameter circle led to still further developments, and an annular nozzle conforming to a 16-in. diameter circle was designed, as the results with the nozzles constructed on a 14-in. diameter circle did not indicate that any limiting conditions in diameter had been reached. This nozzle, which is designated as waffle iron nozzle, style A-5, is shown as Fig. 14. It was tested out in runs No. 54-55 with a 22-in. diameter stack and a 26½-in. inside extension. In this size of stack, the exhaust column missed the stack at the top by an average distance of 3/16 in., though closely

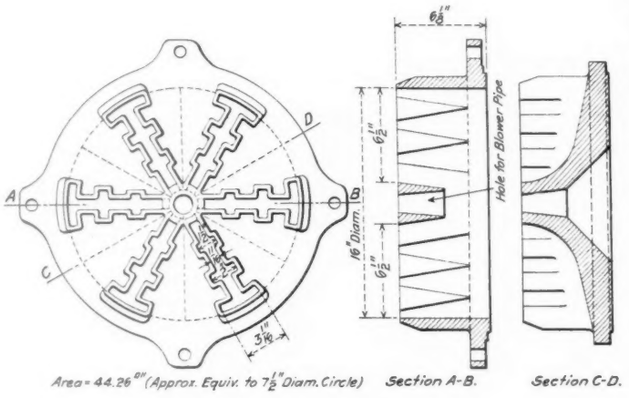


Fig. 14—Waffle Iron Nozzle A-5

hugging the walls of the stack for the upper half of its passage. The exhaust stack diagram for this combination is shown in Fig. 15. The draft conditions were not nearly so favorable as those obtained from either waffle iron nozzle, style A-3, or plain annular nozzle, style A-4a, and the draft efficiency of 0.040 was much lower. This nozzle was later tried with a 20-in. diameter stack in runs No. 64-65. While the exhaust filled the stack at an average distance from the top of 42⅞ in., no improvement in draft condition was observed. The draft efficiency was identical with that obtained from the same nozzle when used with a 22-in. diameter stack. The exhaust stack diagram for this nozzle with the 20-in. stack, is shown in Fig. 16.

In a further effort to find the proper stack to combine with nozzle style A-5, a 26-in. diameter stack with a 26½-in. inside extension was applied. This combination was tested out in runs No. 47-49 and while no better draft conditions were obtained, there was a slight reduction in exhaust pressure which resulted in increasing the draft efficiency to 0.045. The average speed of these runs was slightly below normal, which may have been an influencing factor in reducing the exhaust pressure and consequently improving the item of draft efficiency. The exhaust stack diagram for the combination used in runs No. 47-49 is shown in Fig. 17. With this combination, it will be noticed that the exhaust was clearing the stack, entirely missing it at the top by an average distance of 2¼ in. for the two runs.

A plain annular nozzle was constructed, designed on the lines of a 16-in. circle and conforming to waffle iron nozzle style A-5, except for the shape of the ports. In the style A-5 nozzle, the total length of the exhaust ports was 6½ in., while in the style A-6 nozzle the length was 5½ in. The latter nozzle is shown in Fig. 18. It was tried with three different sizes of stacks. Run No. 66 was made with in Fig. 16. Runs No. 52-53 were made with a 22-in. stack. This resulted in some improvement in the draft production a 20-in. stack with no indication of increased draft or efficiency. The exhaust stack diagram for this run is shown as well as a slight improvement in the draft efficiency, which was 0.042. The exhaust stack diagram, Fig. 15, shows that the exhaust was missing the stack entirely and cleared it at the top by an average distance of 2 1/16 in. A 26-in. stack was applied for runs No. 50-51. The draft was not as high as that produced with the 22-in. stack, although the draft efficiency was 0.001 higher due to a slight reduction in exhaust pressure. By referring to Fig. 17 it will be observed that the exhaust for these runs was clearing the

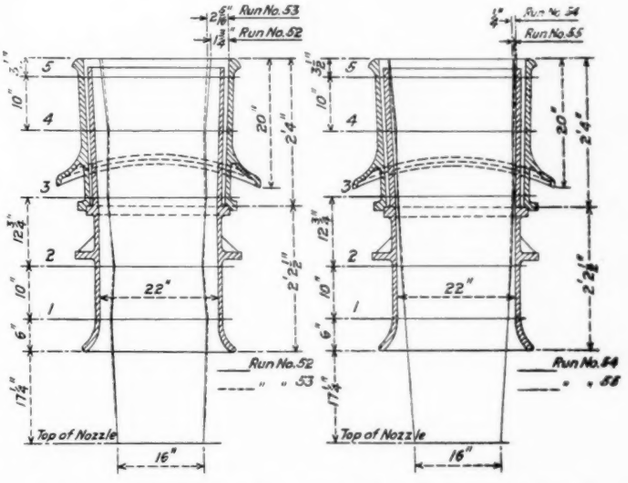


Fig. 15—Exhaust Stack Diagrams for Runs 52, 53, 54 and 55

stack and missing it at the top by an average distance of 4⅞ in. These results appear to contradict what has been observed in previous combinations; i. e., that a better draft condition is produced when the jet strikes well down in the stack. The latter condition prevailed, however, within the range of possible improvement in draft performance and may be considered as a law which obtains within that range, although it does not appear to apply strictly to the combinations when nozzles constructed upon a 16-in. diameter circle were used.

In comparing the results obtained from waffle iron nozzle style A-5 and plain annular nozzle style A-6, it is noticed that the plain annular nozzle did not show as high a degree

*For preceding articles see *Railay Mechanical Engineer* for June, 1918, page 331, and July, 1918, page 387.

of efficiency as the waffle iron nozzle, although the difference is only slight. The highest draft efficiency with the style A-5 nozzle was 0.045, while the highest obtained with the style A-6 nozzle was 0.043.

Since nozzle style A-5 did not properly fill the 26-in. diameter stack, the outside circular edges of the ports were chamfered to an angle of 7 deg. from a horizontal plane and the inside walls of the ports were directed outward to the same extent in order to give more flare to the exhaust jet.

The nozzle thus altered was designated as style A-8 and is shown in Fig. 19. It was tried with a 26-in. stack and a 26½-in. inside extension in runs No. 56-57. A draft of 10.75 in. of water was obtained with a draft efficiency of 0.046, which shows considerable improvement in the draft over that obtained in runs No. 47-49 with the style A-5 nozzle, although the draft efficiency is only increased by 0.001. The exhaust stack diagram for runs No. 56-57 is shown as a part of Fig. 17, from which it is observed that the exhaust is striking well down in the lower portion of the stack, at a point 41 5/16 in. from the top. Here, again, is an exhibition of improved draft obtained by caus-

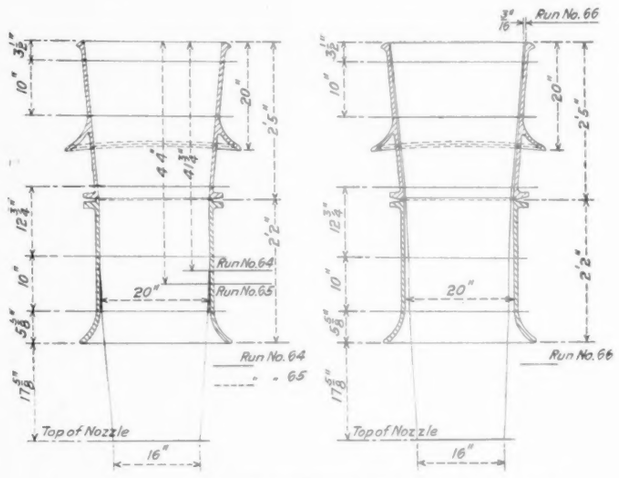


Fig. 16—Exhaust Stack Diagrams for Runs 64, 65 and 66

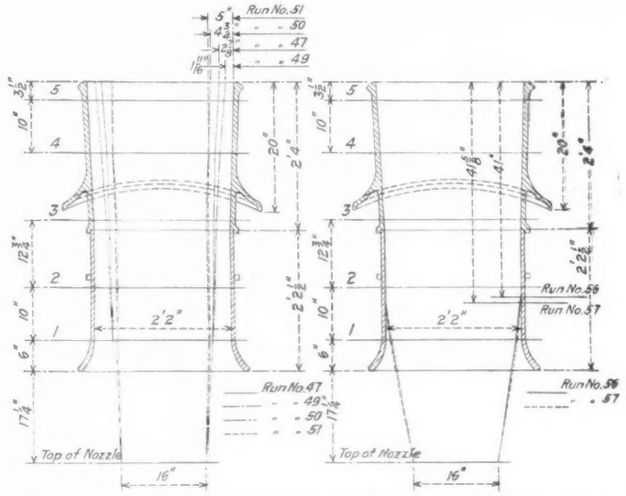


Fig. 17—Exhaust Stack Diagrams for Runs 47, 49, 50, 51, 56 and 57

Table III—Comparison of Nozzle Styles and Sizes of Stacks

Run No.	Stack: Diam., in.	Stack: Length inside extension, in.	Nozzle: Act'l or equiv. diam., in.	Nozzle: Style and diam. bridge	Area	Speed, M. P. H.	Pressure, lb. per sq. in.: Boiler	Pressure, lb. per sq. in.: Exhaust	Draft, in. water: Front end	Draft, in. water: Back of baffle	Draft, in. water: Firebox	† Draft efficiency	‡ Exhaust jet striking, in. from top of stk.
1	2	3	4	5	6	7	8	9	10	11	12	13	14
5	18	26½	7½	S none	44.18	25.7	170.0	6.50	6.10	4.97	1.34	.034	21¼
21–22	22	26½	7½	A-1	44.38	33.5	193.8	8.13	10.39	8.63	1.68	.046	29⅞
23	26	26½	7½	A-1	44.38	30.0	191.0	6.17	8.31	7.04	1.25	.048	— ½
26–27–28	26 Strt.	26½	7½	A-1	44.38	31.0	194.6	6.00	7.95	6.49	1.25	.048	3⅝
39–40*	24	26½	7½	A-2	44.39	32.1	197.4	6.97	10.15	8.56	1.59	.052	39⅝
41–42*	24	26½	7½	A-3	44.32	32.1	192.1	7.57	11.52	9.51	1.57	.055	35 7/16
68–69	24	26½	7½	A-3	44.32	31.8	199.5	8.12	11.94	9.77	1.58	.053	39⅜
43*	24	26½	7½	A-4	44.22	32.1	200.0	9.29	11.70	9.64	2.11	.045	35 9/16
72–73*	24	26½	7½	A-4a	44.23	32.0	200.1	9.00	12.79	10.50	2.04	.051	35⅞
64–65	20	26½	7½	A-5	44.36	31.9	195.7	7.90	8.77	7.39	1.51	.040	42⅞
54–55	22	26½	7½	A-5	44.36	31.9	195.3	8.77	9.74	8.24	1.74	.040	— 3/16
47–49	26	26½	7½	A-5	44.26	29.9	194.2	7.01	8.79	7.36	1.70	.045	— 2⅛
66	20	26½	7½	A-6	44.32	31.6	196.1	9.07	9.91	8.37	1.54	.039	— 3/16
52–53	22	26½	7½	A-6	44.32	32.0	196.8	8.79	10.20	8.50	1.69	.042	— 2 1/16
50–51	26	26½	7½	A-6	44.32	31.2	195.8	7.72	9.29	7.85	1.74	.043	— 4⅞
56–57	26	26½	7½	A-8	44.12	31.3	197.0	8.38	10.75	8.96	1.70	.046	41 5/16
58–59–60	26	26½	7¾	A-9	47.35	30.4	195.0	6.16	7.87	6.72	1.45	.046	— ½
61–62	26	26½	7¾	A-10	47.12	30.2	195.8	5.36	7.65	6.58	1.47	.051	— 1⅜

* Flare of stack increased on these runs.
‡ Exhaust missing the top of the stack is indicated by negative values.
† Draft efficiency equals draft in pounds divided by exhaust pressure.

Table IV—Comparison of Nozzle Styles and Sizes of Stacks

Run No.	Running time, hrs.	Train: No. cars	Train: Tons	Per cent total draft required: Under diaphragm	Per cent total draft required: Through tubes	Per cent total draft required: Through fire	Vacuum between nozzle ports, in. water (see Fig. 18): A	B	C	Water: Pounds	Water: Temp., deg. F.	Equiv. evap. per sq. ft. h. s. per hr.
1	15	16	17	18	19	20	21	22	23	24	25	26
5	.57	16	618.2	18.5	59.5	22.0	.....	.....	.....	.....	.....	.....
21–22	.39	10	605.1	16.9	66.8	16.3	.....	.....	.....	22,950	52.0	14.59
23	.45	11	637.4	15.3	69.7	15.0	.....	.....	.....	23,925	52.5	13.32
26–27–28	.42	12	640.1	18.3	65.8	15.9	.....	.....	.....	21,958	60.7	12.92
39–40	.42	15	628.2	15.7	68.7	15.6	22.41	24.83	19.21	22,975	64.0	13.41
41–42	.42	14	629.7	17.4	69.0	13.6	18.71	18.33	16.63	23,125	64.0	13.50
68–69	.40	14	635.2	18.2	68.6	13.2	17.36	19.59	20.47	23,025	69.0	14.25
43	.42	14	653.1	17.6	64.4	18.0	22.89	31.62	24.44	22,650	63.0	13.40
72–73	.40	14	635.2	17.8	66.2	16.0	20.08	20.76	19.69	20,963	69.3	12.96
64–65	.41	14	624.1	15.6	67.1	17.3	11.15	15.04	13.58	22,425	69.5	13.54
54–55	.40	13	634.8	15.4	66.8	17.8	10.77	12.42	10.77	23,238	66.5	14.23
47–49	.44	15 and 14	632.2	16.2	64.5	19.3	9.21	11.87	8.98	22,938	69.5	12.88
66	.40	14	624.1	15.6	68.9	15.5	8.53	10.86	10.67	22,175	70.0	13.70
52–53	.39	14	627.6	16.7	66.7	16.6	9.90	12.03	10.28	21,700	69.8	13.58
50–51	.42	14	628.0	15.5	65.7	18.8	9.35	10.67	9.35	21,788	69.0	12.83
56–57	.41	14	634.8	16.6	67.6	15.8	12.12	14.55	13.29	23,200	68.0	13.84
58–59–60	.43	15 and 14	632.7	14.6	66.9	18.5	7.76	9.83	8.99	21,367	66.8	12.45
61–62	.42	14	611.5	13.9	66.9	19.2	7.66	10.77	9.80	21,300	66.3	12.43

ing the exhaust jet to strike well down in the stack instead of passing out without coming in contact with the stack walls, as was the case when the nozzle A-5 was used in runs No. 47-49.

Nozzles style A-9 and style A-10, shown in Figs. 20 and 21, respectively, were constructed on the lines of a 16-in. circle but have an area equivalent to the area of a 7¾-in. circle. Nozzle style A-9 is of plain annular type, while style A-10 is of the waffle iron type. Both of these nozzles were tried with a 26-in. stack and a 26½-in. inside extension. Style A-9 was tested out in runs No. 58-59-60, from which an average draft of 7.87 in. of water was obtained with a draft efficiency of 0.046. Style A-10 was used in runs No. 61-62, from which an average draft of 7.65 in. of water was obtained with a draft efficiency of 0.051. The improvement in draft efficiency with the waffle iron nozzle was due to a lower exhaust pressure. The exhaust stack diagrams for these two nozzles are shown in Fig. 22. It will be observed from these diagrams that, under both conditions, the exhausts are missing the stack, yet there is a closer conformity to the stack with the waffle iron style A-10 nozzle than there is with the plain annular nozzle style A-9.

In Table IV are shown data which may be considered with those presented in Table III, there being included certain items which are necessary for a completion of the operating record, but to which attention need not be especially directed. It might be of interest to call attention to items No. 21, 22, and 23, which show the average vacuum observed at the different points between the annular exhaust ports. These readings conclusively demonstrate that there is an active entraining action between the annular exhaust ports, which confirms the original conception of the influence that might be produced by constructing an exhaust nozzle with widely-separated annular ports.

In a review of the results of Table III, it might be stated that, while different types of nozzles and sizes of stacks entered into the various tests, it was observed that the best results were obtained by the use of waffle iron nozzle style A-3, the area of which is equivalent to a 7½-in. circle, used with a 24-in. diameter stack. This nozzle was constructed on a 14-in. circle and corresponded in dimensions and style to the nozzle shown in Fig. 10. Considerable time and expense were expended in an effort to improve upon the results obtained from this combination by different shapes and dimensions of nozzles but without any satisfactory results. It was found in the use of nozzles constructed upon a 16-in. diameter circle that not only was there no improvement indicated over previous designs, but the results did not compare with those

TABLE V—SUMMARY OF BEST RESULTS COMPARED WITH ORIGINAL ARRANGEMENT

	Stack		Nozzle				Pressure, lb. per sq. in.		Draft, in. water				
Run No.	Diam., in.	Length inside extension, in.	Act'l or equiv. diam., in.	Style and diam. bridge	Area	Speed, M. P. H.	Boiler	Exhaust	Front end	Back of baffle	Firebox	† Draft efficiency	‡ Exhaust jet striking, in. from top of stk.
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	18	26½	7	S ⅜	35.86	27.6	189.4	11.44	8.60	7.01	1.26	.027	4 3/16
17	18	26½	7	S ⅜	35.86	33.0	192.5	10.94	8.91	7.25	1.32	.029	— 1⅛
5	18	26¼	7½	S none	44.18	25.7	170.0	6.50	6.10	4.97	1.34	.034	21¼
41–42*	24	26½	7½	A-3	44.32	32.1	198.1	7.57	11.52	9.51	1.57	.055	35 7/16
72–73*	24	26½	7½	A-4a	44.23	32.0	200.1	9.00	12.79	10.50	2.04	.051	35⅞
2	18	26¼	8	S ⅜	47.26	29.0	185.9	6.44	7.36	5.98	1.58	.041	2 11/16
70	24	26½	7⅝	A-3	45.79	31.4	200.8	6.61	10.39	8.54	1.97	.057	39¾
71*	24	26½	7⅝	A-3	45.79	30.6	199.3	5.96	9.54	7.83	1.24	.058	39¾
74*	24	26½	7 15/16	A-4b	49.35	29.5	200.2	4.54	8.63	6.94	1.31	.068	22¼

* Flare of stack increased on these runs.
† Draft efficiency equals draft in pounds divided by exhaust pressure.
‡ Exhaust missing the top of the stack is indicated by negative values.

TABLE VI—SUMMARY OF BEST RESULTS AS COMPARED WITH ORIGINAL ARRANGEMENT

		Train		Per cent total draft required			Vacuum between nozzle ports, in. water (see Fig. 18)			Water		Equiv. evap. per sq. ft. h. s. per hr.
Run No.	Running time, hrs.	No. cars	Tons	Under diaphragm	Through tubes	Through fire	A	B	C	Pounds	Temp., deg. F.	
1	15	16	17	18	19	20	21	22	23	24	25	26
1	...	16	623.7	18.5	66.9	14.6	.....	.....	.....	.....	....	.....
17	.40	9	600.5	18.6	66.6	14.8	.....	.....	.....	21,925	57.0	13.69
5	.57	16	618.2	18.5	59.5	22.0	.....	.....	.....	.....	....	.....
41–42	.42	14	629.7	17.4	69.0	13.6	18.71	18.33	16.63	23,125	64.0	13.50
72–73	.40	14	635.2	17.8	66.2	16.0	20.08	20.76	19.69	20,963	69.3	12.96
2	.47	16	618.2	18.7	59.8	21.5	.....	.....	.....	.....	....	.....
70	.41	14	635.2	17.8	63.2	19.0	.....	15.72	17.27	20,775	69.0	12.53
71	.40	14	635.2	17.9	69.1	13.0	.....	14.16	14.55	20,350	68.5	12.58
74	.43	14	635.2	19.6	65.2	15.2	9.70	9.89	10.09	22,175	69.0	12.76

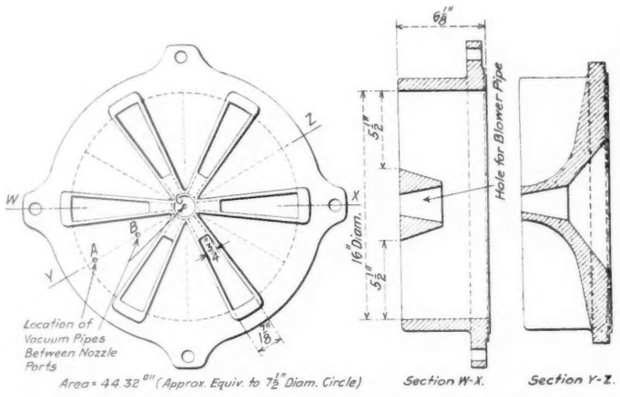


Fig. 18—Plain Annular Nozzle A-6, Showing Location of Vacuum Gages Between the Ports

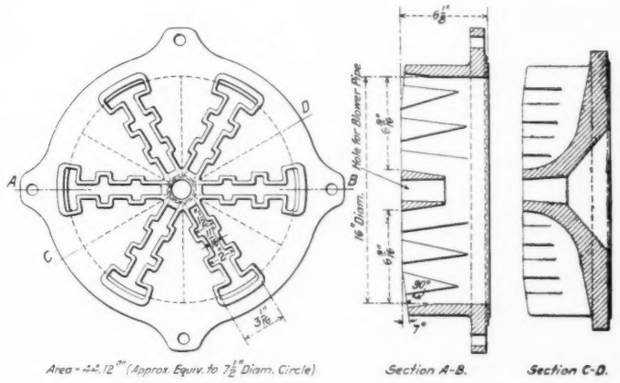


Fig. 19—Waffle Iron Nozzle A-8

already established by the nozzles built on a 14-in. diameter circle.

BEST RESULTS COMPARED WITH RESULTS WITH ORIGINAL ARRANGEMENT

Tables V and VI have been prepared to present a summary of the best results obtained with the different nozzles as compared with those obtained with the locomotive operating in its original condition. The results of runs No. 1 and 17 show the performance of the standard arrangement using a 7-in. diameter nozzle with a 3/8-in. bridge and an 18-in. stack from which it is observed that the average exhaust pressure was 11.19 lb. per sq. in. and the average draft 8.75 in. of water. The average draft efficiency therefore was 0.028.

Run No. 5 shows the results of a standard 7½-in. diameter nozzle without a bridge. The exhaust pressure in this combination was reduced to 6.5 lb., but the front end draft was also reduced to 6.10 in. of water. It will be observed that the average boiler pressure, as well as the speed, were very low, which would place the results of this run on a basis that would not be wholly comparable with the others shown.

Runs No. 41-42 were obtained by the use of waffle iron nozzle style A-3, corresponding in area to a 7½-in. diameter circle and operating with a 24-in. diameter stack with 26½-in. inside extension. The results from this combination were very satisfactory, producing a draft of 11.52 in. of water with an exhaust pressure of only 7.57 lb., resulting in a draft efficiency amounting to 0.055.

Runs No. 72-73 were made with the same stack conditions and the same size nozzle as runs No. 41-42, except that the shape of the nozzle was changed from the waffle iron style to the plain annular style. With this combination, it will be observed that a draft of 12.79 in. of water was obtained but was accompanied by exhaust pressure of 9 lb., resulting in a draft efficiency of 0.051.

In run No. 2, the locomotive was equipped with a standard type of nozzle, 8 in. in diameter, provided with a 3/8-in. diameter bridge. This type of nozzle was used in con-

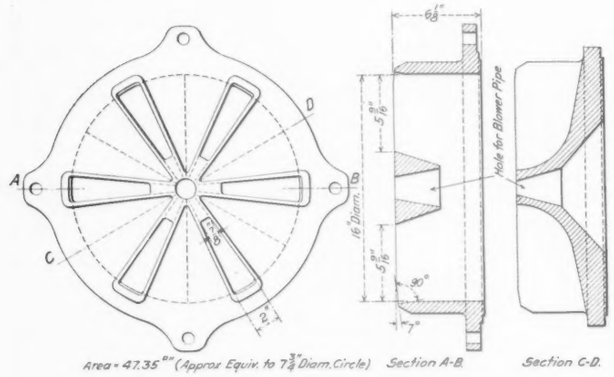


Fig. 20—Plain Annular Nozzle A-9

junction with an 18-in. diameter stack which the exhaust did not fill until near the top. A draft condition was obtained from this combination which was too low to be satisfactory for general service conditions, and led to the further conclusion that little opportunity for improvement in draft results was possible without changing the standard front end equipment.

Runs No. 70 and 71 were made with waffie iron nozzle style A-3, corresponding in area to a 7⅝-in. diameter circle, used with a 24-in. diameter stack and a 26½-in. inside extension. The only difference in these two runs was that in run No. 70 the stack had the standard flare of one inch in diameter in 12 in. of length, while in run No. 71 the flare was increased to two inches in diameter in 12 in. of length. This difference in flare, however, did not appear to have any material influence upon the results of the test. In comparing the draft efficiency of these runs, it is found that there is a difference of 0.001 in favor of the increased flare, which is too small to be positively credited to the difference in the shape of the stack.

Nozzle style A-4b is another of the plain annular nozzles constructed to give an area equivalent to a 7-15/16-in. diameter circle and is shown as Fig. 23. This type of nozzle was used in conjunction with a 24-in. diameter stack, 26½-in. inside extension, in run No. 74, and while the condition of draft was reduced on account of the increased area

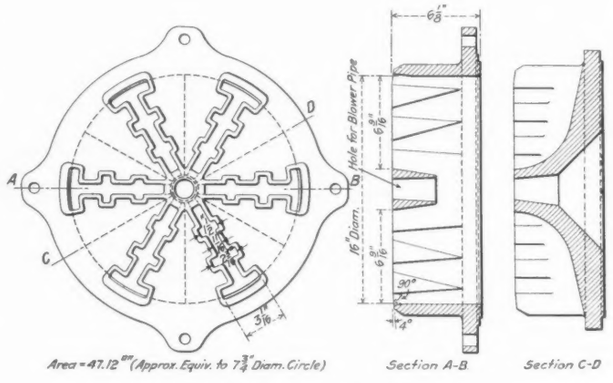


Fig. 21—Waffle Iron Nozzle A-10

of the nozzle, it is observed that the exhaust pressure was considerably reduced. In operating with this nozzle, a draft efficiency of 0.068 was secured. This is a very efficient combination if the condition of draft is sufficiently high to produce free steaming results. It is observed, however, that the draft of 8.63 in. of water is no better than 8.60 in. obtained in run No. 1 with the original standard arrangement, but the exhaust pressure of 4.54 lb. stands out in strong contrast with the exhaust pressure of 11.44 lb., which was a feature of run No. 1.

Table VI furnishes additional information relative to the conditions under which the tests were run, as well as some of the results obtained from these test runs, but as this table does not appear to suggest any lack of uniformity in operating conditions worthy of mention, it will be included in the published data without further comment.

The diagrams in Fig. 24 have been prepared to illustrate graphically the improvement that has been made in draft and exhaust pressure conditions, showing in contrast with the exhaust pressure and draft readings obtained from run No. 17 with the standard equipment, the exhaust pressure and draft readings from runs No. 41, 70 and 74. In the upper section of the diagram the exhaust pressures are plotted, while in the lower section the draft readings are presented. Both items have been plotted against speed in miles per hour. It was found in plotting these diagrams that straight lines appeared to represent the trend of the results within the range of speeds observed, which range was necessarily limited. These straight lines have been drawn through a mean point on the curve, which is representative of the average speed and the average exhaust pressure readings for the exhaust pressure diagrams, and of the average speed and the average draft readings for the draft diagrams.

The high exhaust pressure existing with the standard arrangement is shown by the high position of the exhaust pressure line for run No. 17. It will also be observed in the draft diagram that the results of run No. 17 took the

lowest position; hence it may be said that the standard front end arrangement produced a condition of maximum exhaust pressure and minimum draft. In run No. 41, the reduction in exhaust pressure is remarkable; at the same time the draft conditions have been materially improved. Run No. 70 illustrates a still lower exhaust pressure with draft conditions ranging between the results of runs No. 17 and 41, while run No. 74 shows a remarkably low exhaust pressure with a draft practically equal to that of run No. 17. A comparison of the lines for runs No. 17 and 74 shows impressively the appreciable improvement that has

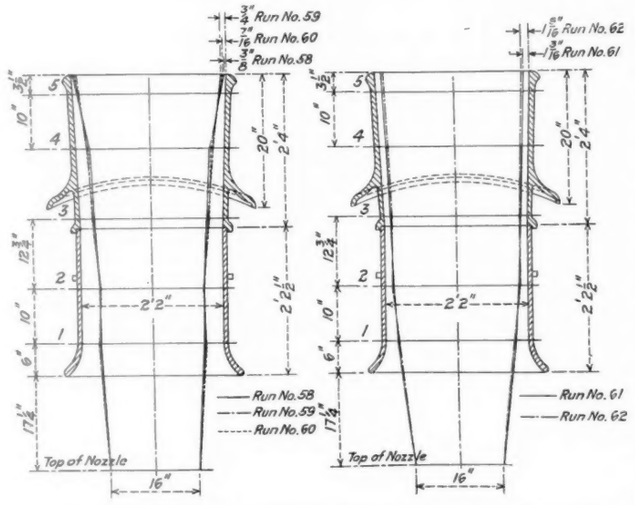


Fig. 22—Exhaust Stack Diagrams for Runs 58, 59, 60, 61 and 62

been accomplished in the reduction of exhaust pressure, while, at the same time, practically equal draft has been maintained.

From the data given in Table V, a selection of the proper front end combination to give the best results can conveniently be made. Operating with a nozzle equivalent to a 7½-in. circle, it is observed that waffle iron nozzle A-3 used in runs No. 41-42 with a 24-in. diameter stack and a 26½-in. inside extension, gave results sufficiently excellent to justify the recommendation of this combination as standard for mountain type class K1 locomotives. If the locomotive can be operated successfully with a lower draft, the waffle iron nozzle, style A-3, may be enlarged to correspond in area to a 7⅝-in. diameter circle, as is illustrated in the results from runs No. 70 and 71; but if the locomotive can be operated successfully with a draft equal to that formerly obtained with the standard equipment, depending upon the reduction in exhaust pressure to improve the performance, it is found that nozzle style A-4b, corresponding in area to a 7-15/16-in. circle, as used in run No. 74 with the same stack combination, will give excellent efficiency results. It may be of interest to state that the first two combinations mentioned have been in service through the winter months without any complaint being registered against the steaming properties of the locomotives. There are now sixteen class K-1 locomotives equipped with the 24-in. stacks and waffle iron nozzles corresponding to either 7½-in. or 7⅝-in. area circles.

It will no doubt be both profitable as well as interesting to draw some deductions as to the effect of the reduction of exhaust pressure upon the performance of the locomotive. Considering again Table V and comparing the average results of runs No. 1 and 17 with the average results of runs No. 70 and 71, it is observed that an average reduction in exhaust pressure to the extent of 4.91 lb. per sq. in. has been obtained in the improved arrangement. This reduction is equivalent to the elimination of resistance in the cylinder to the amount of 139 hp. that is, the engine operating under the above-mentioned conditions is capable of developing 139 more horsepower than it was under the original conditions of operation. At the same time, the draft has been increased from 8.75 to 9.96 in. of water. The difference in the performance of the locomotive due to the change in front end arrangement is still more pronounced when applied to the results obtained with the style A-4b nozzle with area equivalent to 7-15/16-in. diameter circle, where a reduction in back pressure of 6.65 lb. per sq. in. was obtained. This is equivalent to a reduction in cylinder resistance of 188 hp. Under this condition, however, the draft has not been improved, in fact it is slightly lower, being 8.63 in. while the average of the two runs with the standard equipment was 8.75 in.

This reduction in exhaust pressure not only means an increase in the power of the locomotive, but it suggests a decrease in fuel consumption on the basis of equal work demanded. Assuming 5½ lb. of coal per i. hp. hr., which is a conservative assumption, the locomotive equipped with the waffle iron nozzle, style A-3, working under the same load conditions as formerly, should consume 764 lb. less coal per hour, while the locomotive equipped with the style A-4b nozzle, working under the same conditions of load and speed as formerly should consume 1,034 lb. less coal per hour.

While no accurate account was taken of the coal consumption during the progress of the test, a quite perceptible difference in fuel consumption was observed after certain of the annular nozzles were applied. In runs with the standard front end arrangement it was not possible with a full tender of coal to run from Roanoke to Christiansburg and then make two additional runs from Elliston to Christiansburg, but after the more efficient annular nozzles were

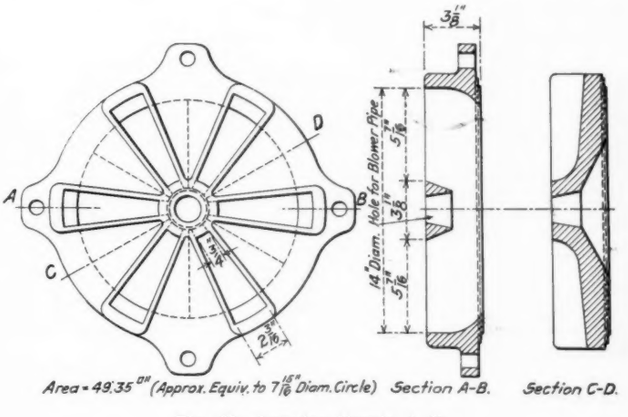


Fig. 23—Annular Nozzle A-4b

applied it was possible to run from Roanoke to Christiansburg and then make two, and sometimes even three, trips between Elliston and Christiansburg without securing additional fuel.

CONCLUSIONS.

The foregoing consideration of the data obtained from these tests leads to the following conclusions:

(1)—Considering the original standard nozzle, it was found that slightly higher draft and draft efficiency were obtained by the use of a bridge. The only exception to this law was the comparison with the 9-in. inside stack extension, in which the draft efficiency was higher but the draft itself was reduced.

(2)—In determining the proper length of inside extension for the stack and the proper location for the exhaust

column to strike the stack, it was shown that the best results were obtained with the long extension, which was 26½ in. long measured from the joint, or 35 in. measured from the smoke arch. Shortening the inside stack extension has the same effect upon the relationship of the exhaust column and the stack as increasing the size of the stack. It was further observed that the best draft conditions were obtained when the exhaust struck the walls of the stack at a distance from the top equal to 70 per cent of the total length of the stack.

(3)—It was further conclusively demonstrated that the possibility for improvement with the present standard type of nozzle was exceedingly limited, as the various alterations in the sizes of the standard nozzle with and without a bridge and variations in stack dimensions did not suggest the possibility of any marked improvement over the original arrangement.

(4)—The best results were obtained with annular-shaped nozzles constructed on a 14-in. diameter circle, used with a 24-in. diameter stack and a 26½-in. inside extension. The draft required to guarantee a free steaming locomotive under normal conditions will govern the size of the nozzle ports.

Recognition should be given especially to the fact that

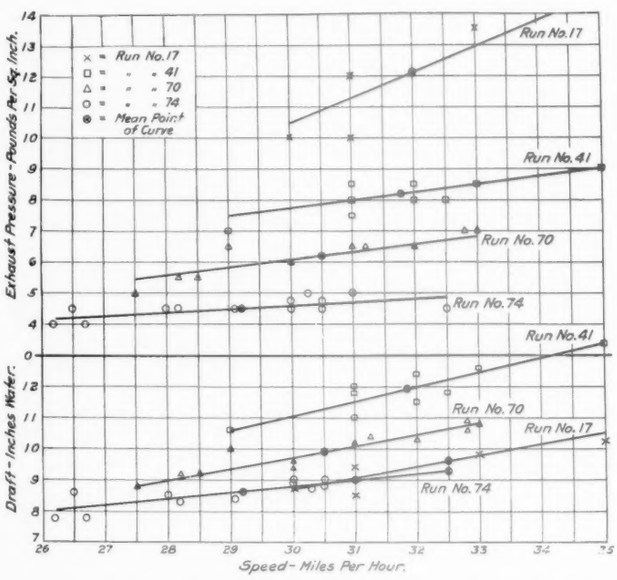

Exhaust Pressure - Pounds Per Sq. Inch.
Draft - Inches Water.
Speed - Miles Per Hour.
× = Run No. 17
□ = " " 41
△ = " " 70
○ = " " 74
● = Mean Point of Curve
Run No. 17
Run No. 41
Run No. 70
Run No. 74
Run No. 41
Run No. 70
Run No. 17
Run No. 74

Fig. 24—Exhaust Pressure and Draft Diagrams for Runs 17, 41, 70 and 74, Showing Graphically the Improvement Effected in Draft Efficiency.

the data secured and the results obtained were made possible by the opportunity presented for the operation of the locomotive in special service, where all of the operating conditions were under the control of those in charge of the test. To this opportunity is due the ability to observe the effect of slight changes in the front end arrangement which could not have been detected under less favorable conditions.

The results that have been obtained by changing the front end arrangement of this class of mountain-type locomotives suggest that there is a wide field for improvement in draft conditions on other modern types of locomotives, and it is not at all improbable that the same principles might be applied to smaller locomotives with equally good results. As has already been stated the same principles are now being applied to a Norfolk & Western class M-2 Consolidation type freight locomotive. Encouraging results have already been realized in an increase of 39 per cent in draft, a decrease of 22 per cent in exhaust pressure, and an increase in draft efficiency of 76 per cent. Efforts are being continued with the expectation of augmenting this favorable showing.

RULES FOR DELIVERY AND TRANSFER OF LOCOMOTIVES

The following rules for the purpose of expediting the delivery of new locomotives from the builders and also of facilitating the movement of locomotives to and from foreign line shops for repairs will be issued at the instance of Frank McManamy, mechanical assistant to the director of the division of operation:

Builders will be required to put the locomotive in condition for service before leaving the plant, and new road locomotives, except oil burners moving over lines which are not equipped to provide fuel, will be delivered under steam and be used in hauling a train when practicable. They will be accompanied by a messenger furnished by the builders, whose duties will be to see that bearings run cool and that the machinery is properly cared for until the locomotive is delivered.

Road locomotives repaired at foreign line shops will be returned to the home line under steam, hauling a train when practicable.

Road locomotives sent to foreign line shops for repairs will be sent under steam when their condition will permit, hauling a train when practicable.

Each road will give to such locomotives the same care and attention they give their own power and will be held responsible for their condition whether delivered to connections or home line.

The use of such locomotives when moving under steam will be accepted as full payment for transportation charges.

Such locomotives will be given preferred movement and will not be held at terminals except for rest for crews, and necessary repairs. Switching locomotives and other light locomotives not suitable for service on delivering line, and oil burners passing over lines which are not equipped to provide fuel, may be handled dead in train in the usual way.

To avoid disputes as to payment of rental for United States locomotives when transferred from one railroad to another, the following rule will govern: "All mechanical delay at the point of delivery, i. e., the necessary delay in making the locomotive ready for service, will be charged to the delivering road. All delay at such points after the locomotive is made ready for service will be charged to the receiving road."

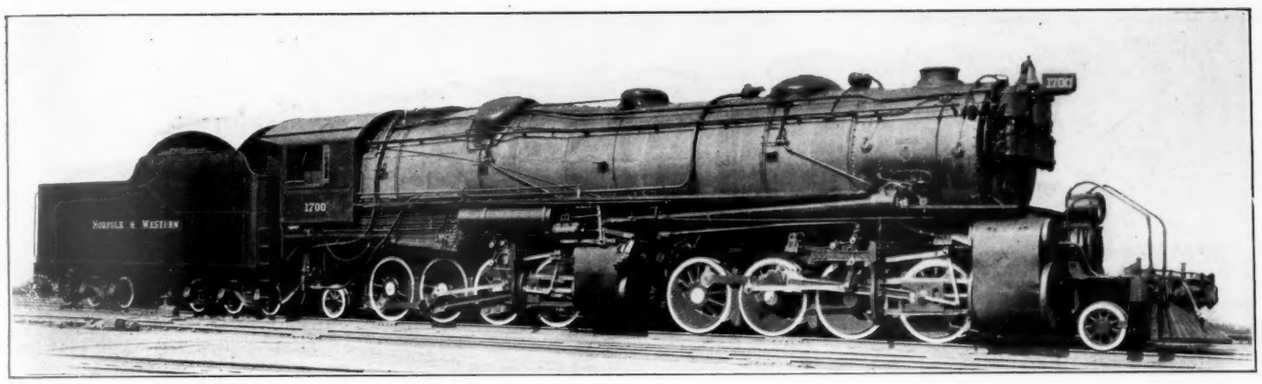
SCHEDULE FOR THE APPLICATION OF SUPERHEATERS

Circular letters have been sent out by the regional directors, stating that for the purpose of helping to conserve fuel and increase the efficiency of locomotive operation, it has been decided to put into effect a locomotive superheater schedule as follows:

1. Locomotives in shop receiving Class 1, 2 or 3 repairs will be superheated as material is available and labor conditions will permit.

2. Locomotives in freight or transfer service, having 30,000 lb. or more tractive power, and in passenger service having 25,000 lb. or more tractive power, will have preference, and locomotives with the longest prospective life will be first equipped.

3. If superheater material is on hand for locomotives not covered by the above ruling it should be used on smaller engines if not interchangeable with larger ones; the idea being to obtain the benefit of its use rather than to have it remain in stock because of not conforming to the above requirements.



N. & W. 267-Ton Mallet Locomotive

Tractive Effort 104,300 Lb. Compound, 135,600 Lb. Simple; The Tender and Its Trucks of Unusual Design

BY H. W. REYNOLDS

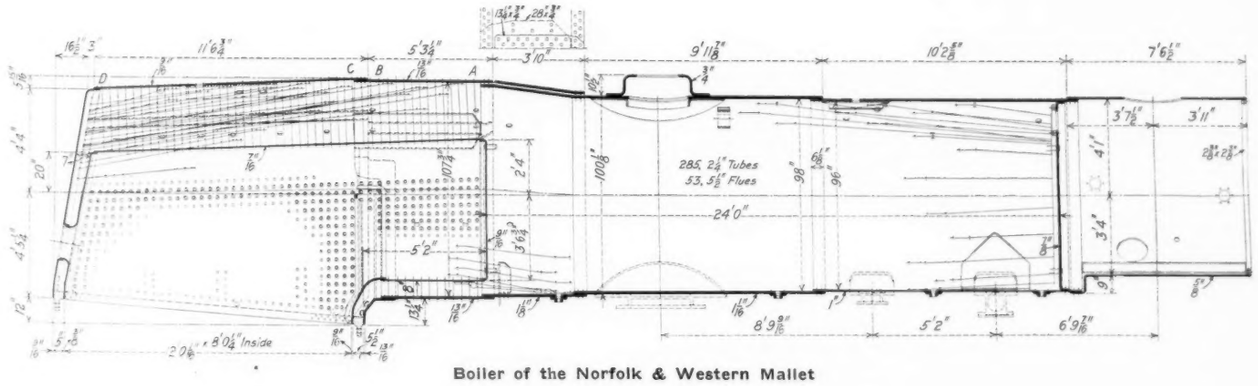
THE Norfolk & Western has used Mallet locomotives in general road service for the past five years. Realizing the need of a more powerful locomotive of this type, it has built and now has in use a large 2-8-8-2 Mallet. This locomotive, known as Class *Y2*, was built in the company's shops at Roanoke, Va.

On account of the limited clearances, compactness in design was necessary in order to obtain proper proportions. It was found that low pressure cylinders 39 in. by 32 in. were as large as could be used, and in order to secure a cylinder ratio of 2½ to 1 it was necessary to use high pressure cylinders 24½ inch by 32 inch, and a boiler pressure of 230 lb. per sq. in. Another evidence of close clearances will be seen in the arrangement of the pop valves, which are laid flat on the boiler, with a shield between them to deflect the steam upward. It will also be noticed that the air pumps and bell are located on the boiler front, the bell being operated by means of a Gollmar bell ringer.

Both high and low pressure cylinders are equipped with piston valves. The valves in the low pressure cylinder are 17 in. in diameter, while those of the high pressure cylinders are 14 in. in diameter. In order to obtain steam and exhaust passages of ample area, free from abrupt bends, it was found desirable to make the low pressure valves outside admission. The McCord force feed lubricator is used for lubricating the low pressure cylinders. This lubricator is used to eliminate the flexible connections in the oil pipes to the low pressure cylinders, which have been a source of trouble. All other cylinder lubrication is furnished by sight feed lubricators.

The pistons are built up of cast steel centers with cast iron wearing rings. While this design is not as light as the rolled steel piston, it is desirable because of the ease with which a new wearing ring may be applied, without necessitating the piston being again fitted to the rod.

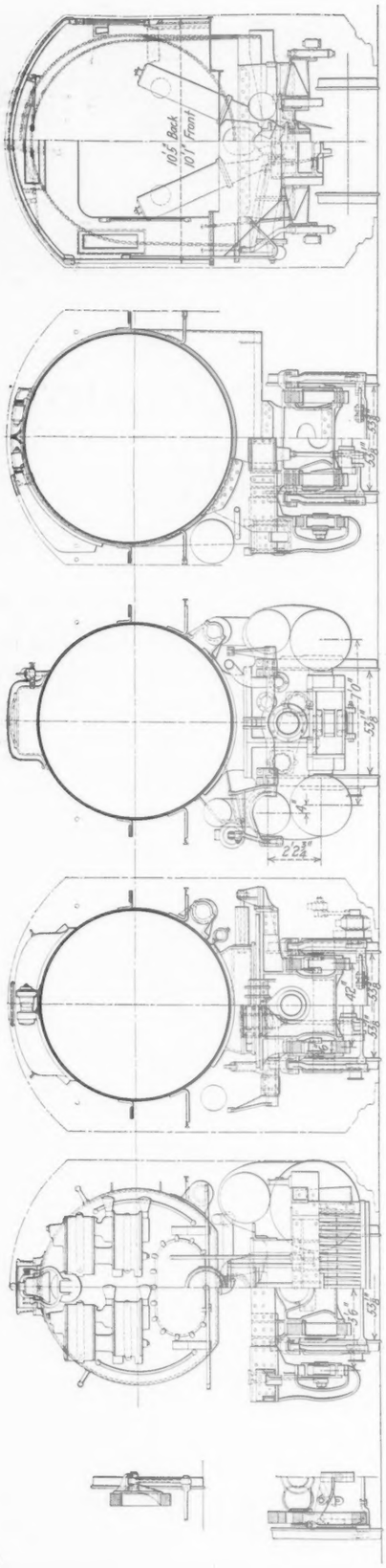
Steam distribution is controlled by the Baker valve gear and the Norfolk & Western Class *KY* standard power reverse gear. Hancock pneumatic cylinder cock operating cylinders actuate the cylinder cocks, and the grates are operated by means of the Franklin steam grate shakers.

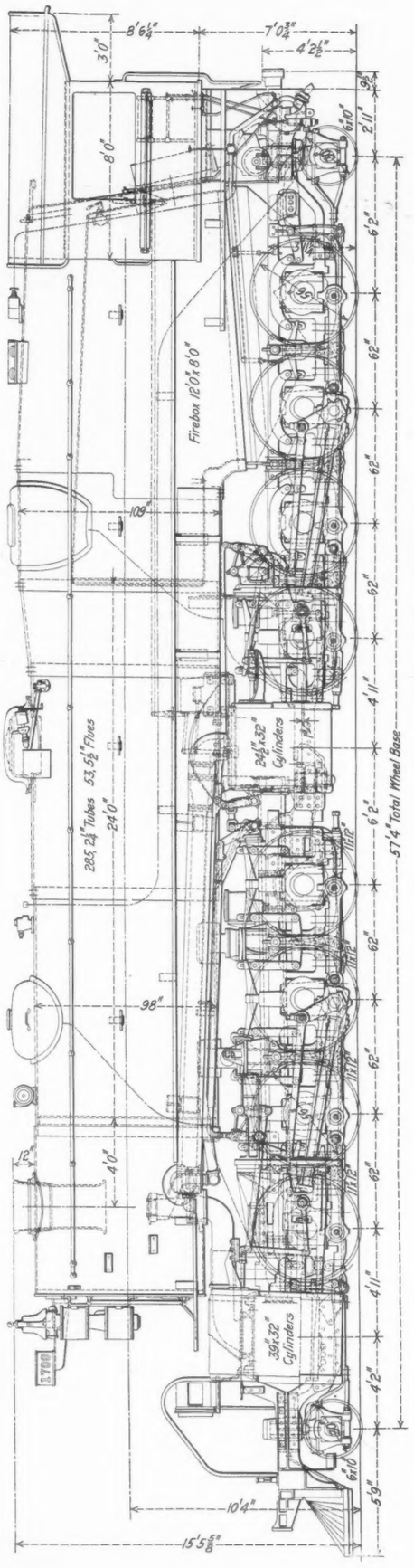


Boiler of the Norfolk & Western Mallet

The driving wheels are equipped with flanged tires throughout and the locomotive is designed to take 18-deg. curves. The frames, driving boxes, driving wheel centers and all frame braces are of cast steel. The cylinders are of gun iron. Care was exercised in the design of all castings and cast steel was used liberally in order to reduce the weight and secure a boiler of ample proportions.

The boiler is of the extended wagon top type, with a central dome and is equipped with a 53-unit Type A superheater. The firebox with its liberal grate surface of 96 sq. ft. is equipped with the Security arch supported on five water tubes 3 in. in diameter. There are 53 flues 5½ in. in diameter, and 285 tubes 2¼ in. in diameter, 24 ft. long over

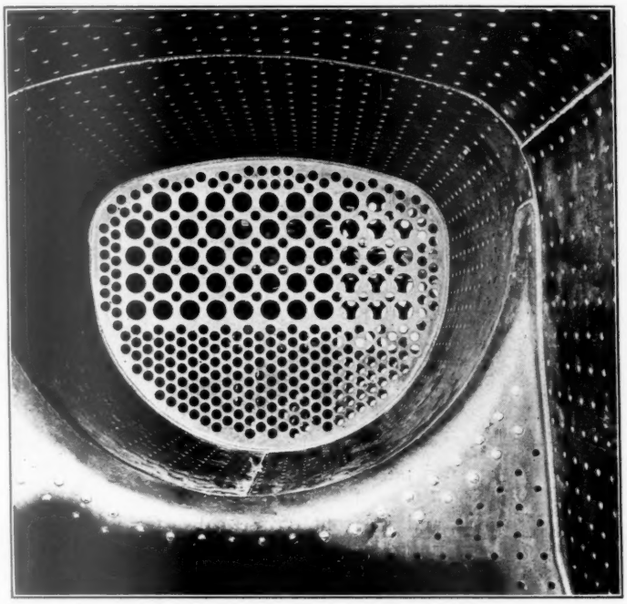




Elevation and Sections of the Norfolk & Western Mallet Locomotive

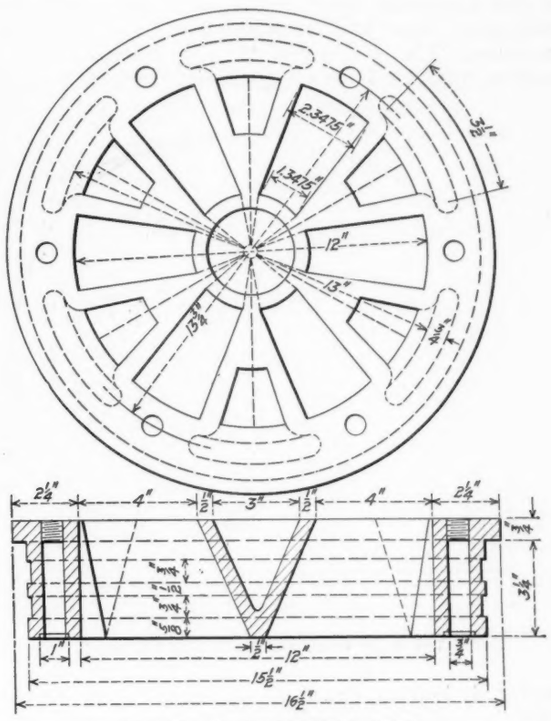
tube sheets, and a combustion chamber 5 ft. 2 in. in length.

The front end is arranged for the use of an annular ported exhaust tip. The ports are laid out in a 12-in. circle and are proportioned to provide an area equivalent to that of an 8-in. circular nozzle. The emergency exhaust from the high pressure cylinders is led through an elbow, cast integral with the exhaust stand, to an outside annular chamber. This discharges through an opening in the exhaust tip placed between the low pressure exhaust ports. The exhaust pipe discharges into an inside extension stack 22 in. in diameter, the bottom of which is located about 22 in. above the tip.

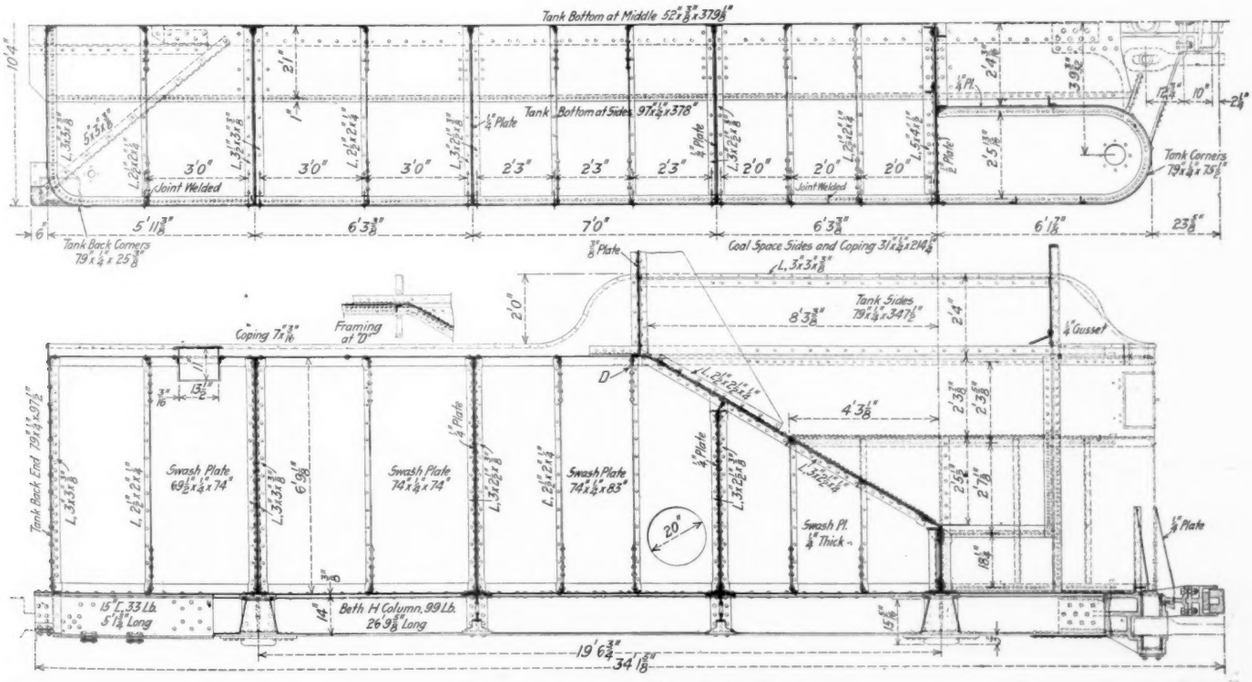


Electrically Welded Firebox Seams

An unusual feature of boiler construction will be noticed in the fourth ring over the combustion chamber. By using a thin plate 13/16 in. thick in this location, over 3,000 lb. of boiler plate steel was saved and the required strength of the boiler maintained. The dome is located on the second course of the boiler just in front of the gusset sheet, in order to obtain sufficient height for the Chambers' throttle valve. The firebox and combustion chamber of the boiler are electrically welded throughout, thus eliminating flanging and the possibility of cracks after two or three years of service. The tubes are located well up in the back tube sheet to prevent clogging.



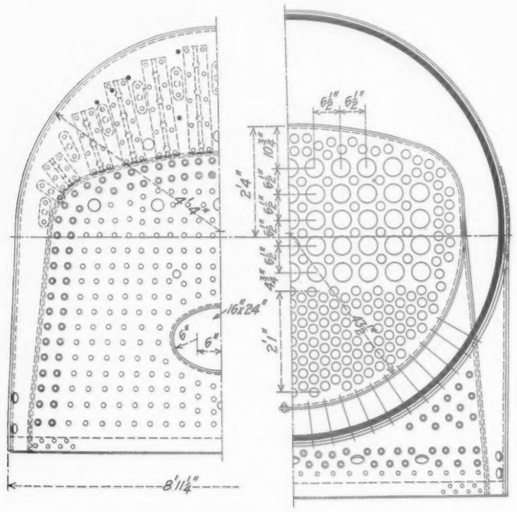
The Annular Ported Exhaust Tip


Tank Bottom at Middle 52" x ⅜" x 379⅛"
Tank Bottom at Sides 97" x ½" x 378"
Joint Welded
Tank Corners 79" x ¼" x 75⅛"
Tank Back Corners 79" x ¼" x 25⅛"
Coal Space Sides and Coping 31" x ¼" x 214⅛"
Tank Sides 79" x ¼" x 347⅛"
Coping 7" x ⅜"
Framing at "D"
Swash Plate 69½" x ¼" x 74"
Swash Plate 74" x ⅜" x 74"
Swash Plate 74" x ¼" x 83"
Swash Pl. ⅜" Thick
Tank Back End 79" x ½" x 97⅛"
15" I. 33 Lb. 5'1⅛" Long
Beth H Column, 99 Lb. 26'9⅛" Long
19'6¾"
34'1⅛"

Elevation and Half Plan of the Tank

It has been found that a number of the lower tubes located close to the bottom of the sheet are practically of no value, as they require constant attention to keep them open.

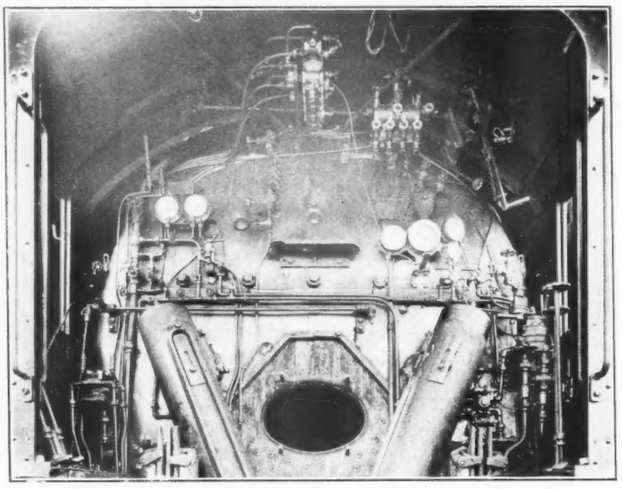
The boiler is fitted with the Sentinel low water alarm. The value of this device lies not only in the elimination of burnt or damaged crown sheets, but the water in the boiler may be worked at a lower level, resulting in increased superheat temperatures. The efficiency of the superheater on large locomotives, particularly on those with long boilers, is frequently



The Back Head and Tube Sheet Layout

perceptibly lowered, due to the tendency of some engineers to carry the water at too high a level. Perfect confidence may be had when carrying the water at a low level on a locomotive equipped with this alarm, for the reason that sufficient time remains after the alarm has sounded to fill the boiler to the proper level without danger of damage.

Two Sellers non-lift injectors, each having a capacity of 7,500 gal. of water per hour, are located one on each side of the engine under the cab with the steam control valves



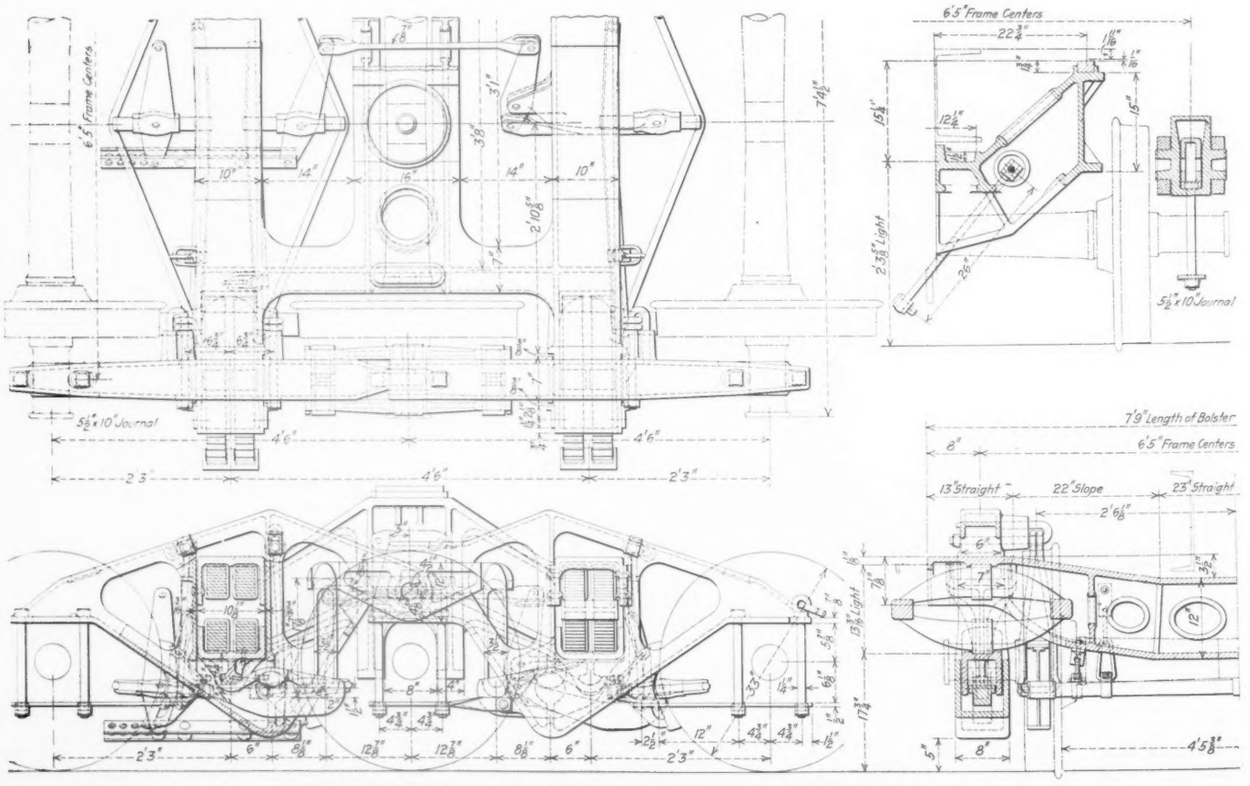
Interior View of the Cab

located outside and in front of the cab. Coal is fired by means of the Duplex stoker, and from road tests the boiler has been found to steam freely.

The smokebox front is of steel plate in order to provide support for the air pumps.

Among the special features of the equipment of the locomotive are Radial buffers, Graham-White Perfect sanders, and Pyle type K headlight equipment.

The construction of the tender differs materially from usual

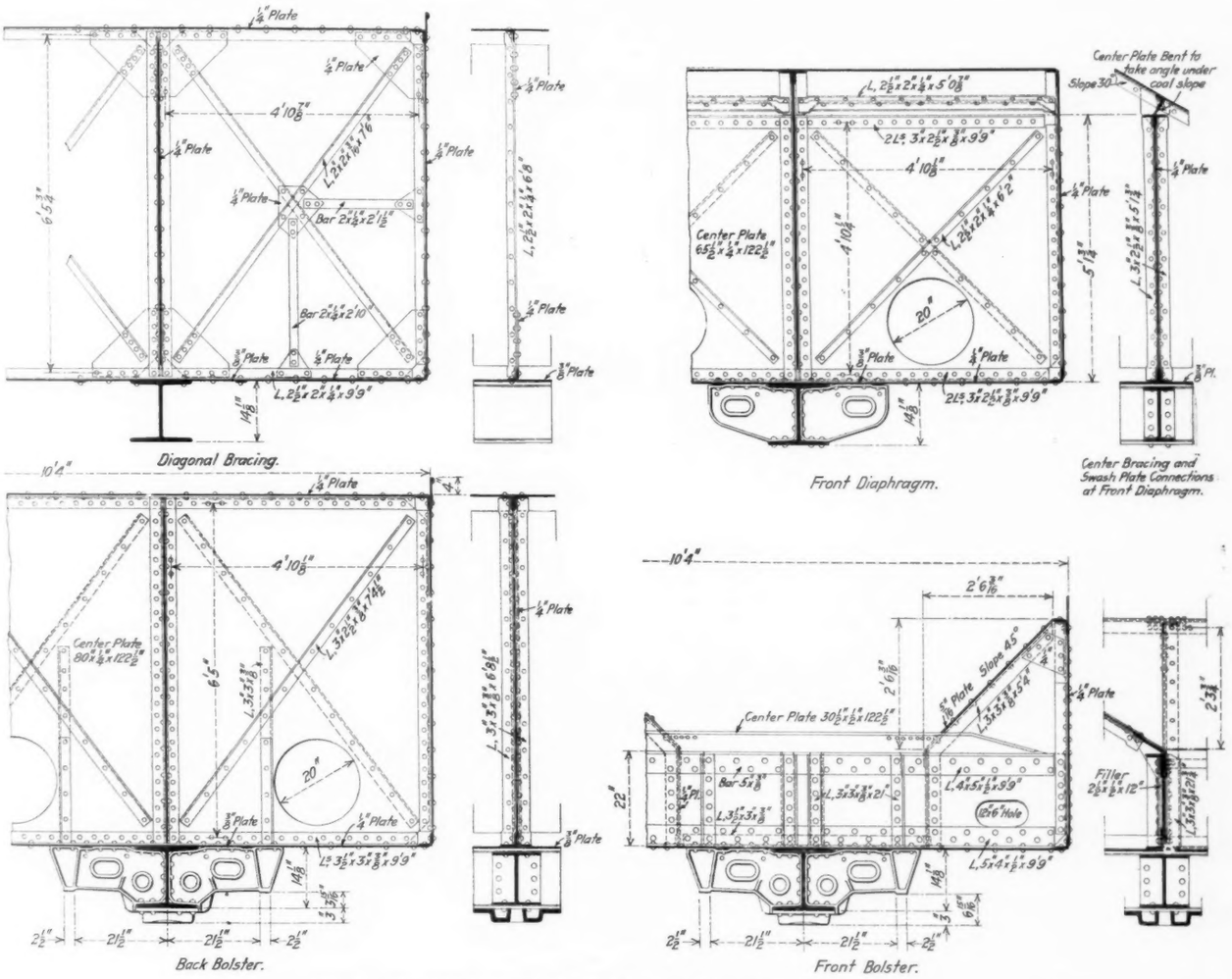


Plan and Elevation of the Norfolk & Western Class T-27 Tender Truck

practice. The tank is made of structural shapes and the frame is built into it, resulting in increased strength and decreased weight. The body bolsters are located in the tank over the truck centers and two intermediate diaphragms are located between the body bolsters. Between the diaphragms, between diaphragms and bolsters, and between the rear bolster and the end of the tank, lateral bracing is placed to furnish the necessary strength against bulging. The center sill, riveted underneath the tank, is a Bethlehem H-section, which extends from a point just in front of the front truck center to a point back of the rear truck center. Carefully fitted and riveted to the front end of the center sill is a steel casting arranged to support the front water legs. This casting also contains pockets to receive the drawbar and safety bars. A steel casting is riveted to the back end of the center sill, to either side of which draft arms are riveted. These draft arms extend to the rear of the tank, where they are held in position by knee braces built up of plates and angles. Sessions draft gear is used in connection with the Farlow one-key attachment.

Short steel castings arranged with side bearings are fitted each side of the center sill over the truck centers and are securely riveted to the center sills and tank floor. These castings serve to transfer the load from the body bolsters to the truck centers. Cast steel knees are riveted to the center sill and tank floor at each diaphragm to provide the center sill with lateral stiffness. The tender has a capacity of 12,000 gal. of water and 20 tons of coal. The design has been found to be very successful.

The tender is carried on two 75-ton six-wheel non-pedestal trucks, the design of which is a departure from the Lewis six-wheel freight car truck in use on the Norfolk & Western. Helical springs are used in the Lewis truck and the openings in the side frames for receiving the springs and bolster arms are so located as to throw two-thirds of the load coming on each side frame on the journal boxes of the outside pairs of wheels. By this method proper weight distribution is obtained, but it is necessary in order to keep the wheel base within reasonable limits to have the nest of springs in each side frame close to the outside pairs of wheels and arrange the neck of the body bolster to clear the wheels with springs solid. When the attempt was made to use elliptic springs on the Lewis truck it was found difficult to get them in and clear the wheels, so the 75-ton elliptic spring tender truck, known as Class T-27, was developed. On this truck the openings in the side frames are located midway between each two pairs of wheels. This location causes the middle pair of wheels to be loaded in a larger proportion than the outside pairs. In order to remove the excess load from the middle wheels, the elliptic springs are placed on seats, each of which rests on one end of a lever pivoted in the side frame between the opening and the middle wheels. The other end of each lever rests against the bottom end of a strut, the top ends of which react against the end of a lever pivoted to the side frames



Sections Showing the Tender Bolster and Diaphragm Construction

over the middle journal boxes. It will be seen that with the levers properly proportioned, the weight on the springs will cause an upward thrust to be exerted on the levers pivoted to the side frames over the middle journal boxes equal to the amount of the excess weight on the middle pair of wheels. This relieves the middle wheels of the excess loading and gives the same weight on the rail for all three pairs of wheels.

To one side frame on each side of the truck is bolted rigidly the journal boxes of the outer and middle pairs of wheels, while to the other frame is bolted the journal box of the outer pair of wheels, and the end of the frame is passed into and rests on the rigid side frame over the middle journal box to form a flexible connection.

The usual practice of making the members at the top and bottom of the side frame openings parallel is not followed for the reason that the load is applied to the side frames at a single point under the center of the columns next to the middle wheel, the columns and wearing surfaces toward the outer wheels acting only as guides for the bolster arms. This permits the side frames being designed in perfect truss form.

Axles with standard M.C.B. 5½ in. by 10 in. journal boxes are used. The brake beams are hung from the side frame and the design of brake rigging is the same as that in use on the Lewis truck. The truck bolster is of cast steel in one piece, with the ends of the arms arranged to fit over and rest on the elliptic springs. On account of ample space being provided by the design of the tank, the side members of the body bolster are made deep where they pass over the middle axle. Ample wearing surfaces are provided, and the absence of all bolts and pin connections will be noted.

The principal data and dimensions of this locomotive are:

GENERAL DATA	
Gage	4 ft. 8½ in.
Service	Freight
Fuel	Bit. coal
Tractive effort, compound	104,300 lb.
Tractive effort, simple	135,600 lb.
Weight in working order	535,000 lb.
Weight on drivers	472,000 lb.
Weight on leading truck	28,000 lb.
Weight on trailing truck	35,000 lb.
Weight of engine and tender in working order	747,000 lb.
Wheel base, driving, both units	15 ft. 6 in.
Wheel base, total	57 ft. 4 in.
Wheel base, engine and tender	92 ft. 11¼ in.
RATIOS	
Weight on drivers ÷ tractive effort	4.52
Total weight ÷ tractive effort	5.13
Tractive effort × diam. drivers ÷ equivalent heating surface*	680.6
Equivalent heating surface* ÷ grate area	89.4
Firebox heating surface ÷ equivalent heating surface,* per cent	5.6
Weight on drivers ÷ equivalent heating surface*	55.0
Total weight ÷ equivalent heating surface*	62.3
CYLINDERS	
Kind	Compound
Diameter and stroke	24½ in. and 39 in. by 32 in.
VALVES	
Kind	Piston
Diameter	H. P., 14 in., L. P., 17 in.
WHEELS	
Driving, diameter over tires	56 in.
Driving, thickness of tires	3 in.
Driving journals, main, diameter and length	11 in. by 12 in.
Driving journals, others, diameter and length	11 in. by 12 in.
Engine truck wheels, diameter	30 in.
Engine truck, journals	6 in. by 10 in.
Trailing truck wheels, diameter	30 in.
Trailing truck, journals	6 in. by 10 in.
BOILER	
Style	Wagon top
Working pressure	230 lb. per sq. in.
Outside diameter of first ring	98 in.
Firebox, length and width	12 ft. by 8 ft.
Firebox plates, thickness	7/16 in.
Firebox, water space	Front 5½ in., back 5 in., sides 4½ in.
Tubes, number and outside diameter	285—2¼ in.
Flues, number and outside diameter	53—5½ in.
Tubes and flues, length	24 ft.
Heating surface, tubes and flues	5,834 sq. ft.
Heating surface, firebox including arch tubes	482 sq. ft.
Heating surface, total	6,316 sq. ft.
Superheater heating surface	1,510 sq. ft.
Equivalent heating surface*	8,581 sq. ft.
Grate area	96 sq. ft.
TENDER	
Tank	Water bottom
Weight	212,000 lb.
Wheels, diameter	33 in.
Journals, diameter and length	5½ in. by 10 in.
Water capacity	12,000 gal.
Coal capacity	20 tons

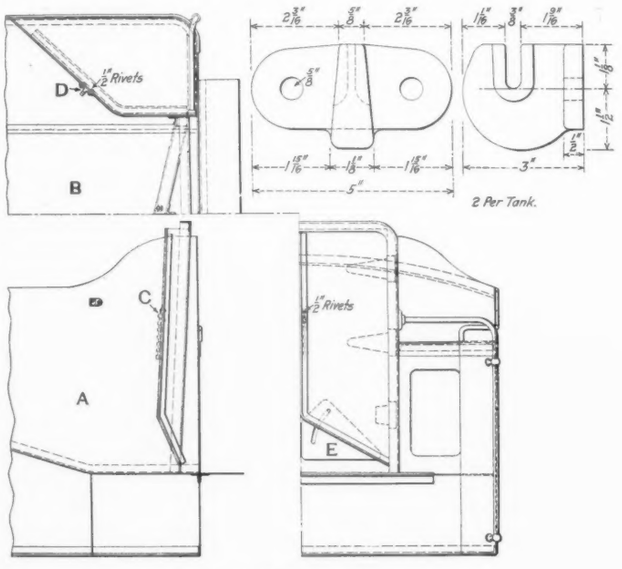
*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

COAL GATE HOLDERS

BY JOHN H. NAGLE
Chief Draftsman, Buffalo, Rochester & Pittsburgh

Many forms of coal gate holders on locomotive tenders are in use and it is often difficult to keep them in good condition because they are subject to hard service, especially when loading the tanks at terminals.

To overcome this difficulty, the B. R. & P. has designed a simple arrangement composed of a chain and keeper. Referring to the illustration, *A* is an elevation and *B* a plan view of the tank showing the detail arrangement of coal gate, chain and keeper. The chain is a ¼-in. straight link standard chain, which is firmly riveted to the inside of the gate as indicated at point *C*. The keeper is also firmly



Coal Gate Holders

attached to the tank by ½-in. rivets as indicated at point *D*.

With this device the gate may be held in any position desired by simply hooking the proper link of the chain into the keeper. When the coal gates are closed the chains hang free, there being, of course, a chain and keeper for each door.

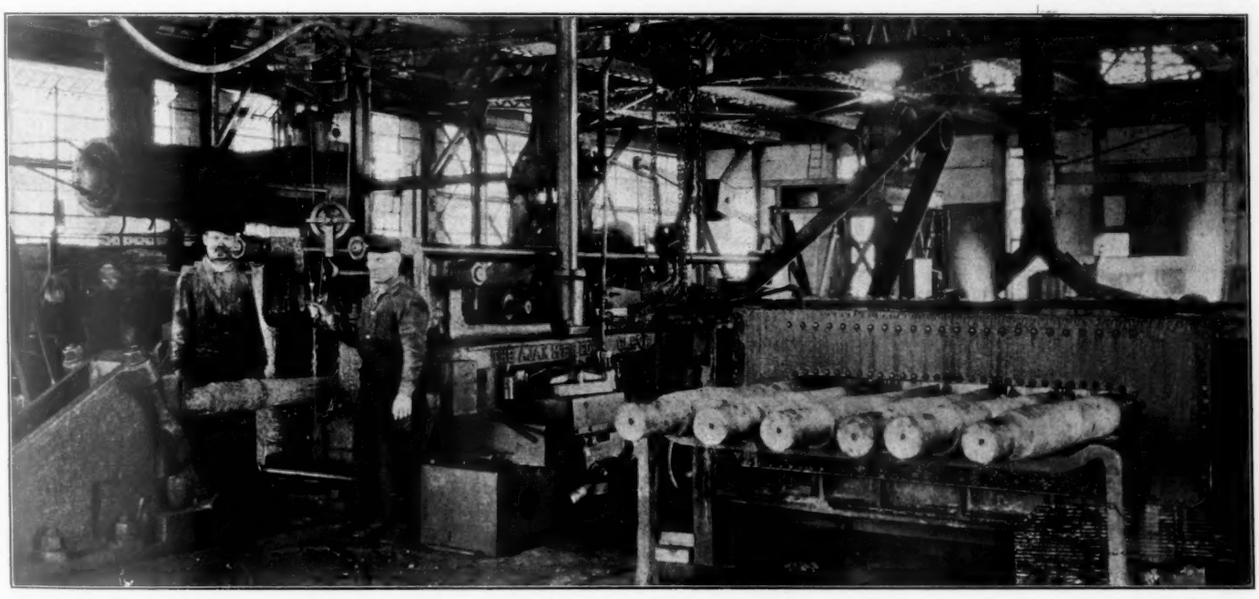
The small lifting gate marked *E* has been found useful in preventing the loss of coal, as for example, when moving a dead engine with a loaded tank. The entire arrangement has been satisfactory, meeting all the requirements of the enginemen and has, therefore, been adopted as standard.

TRAINS BY WATER-POWER.—The special correspondent of the Daily Mail, London, reports that in a debate on railways in the Spanish Senate, Senor Cambo said the government was occupied with a large scheme for the development of hydro-electrical energy, and more than hinted at the existence of a plan for working thus the main railways of the country. As the industrial development of Spain is held up for lack of communications and transport, and as transport at present depends on coal, the importance of this project can hardly be exaggerated. It is interesting to note also that practically all hydro-electrical plants in the country are run with German machinery, and that their usual commercial forethought has been displayed in a systematic cultivation of the subject as well as in a good deal of surveying and buying of properties where this power could be developed on a large scale. There is enough water-power in Spain to do the whole work of the country.

RECLAIMING CAR AXLES

The enormous increases in the prices of iron and steel products since the outbreak of the war have created a greater incentive for reclaiming materials. Heavy parts which are used in large numbers furnish especially attractive fields for effecting savings. Until quite recently the reclaiming of car axles has been practiced by very few roads, but at the present time it is being done at a number of shops and by a variety of methods.

There is no single process which is best under all conditions. There are four common defects for which axles, otherwise in good condition, may be removed from service. The collar may be too thin or the journal may be too long or the diameter of the wheel seat or journal may be under the limiting dimensions. In the first two cases the axle can be built up at the point where the greatest wear has occurred by welding. The chief advantage of this method is that the axle after reclaiming is of the same nominal capacity as before. In case the diameter of the wheel seat or the journal is below the limit, it is the usual practice to convert the axle to the next smaller size.

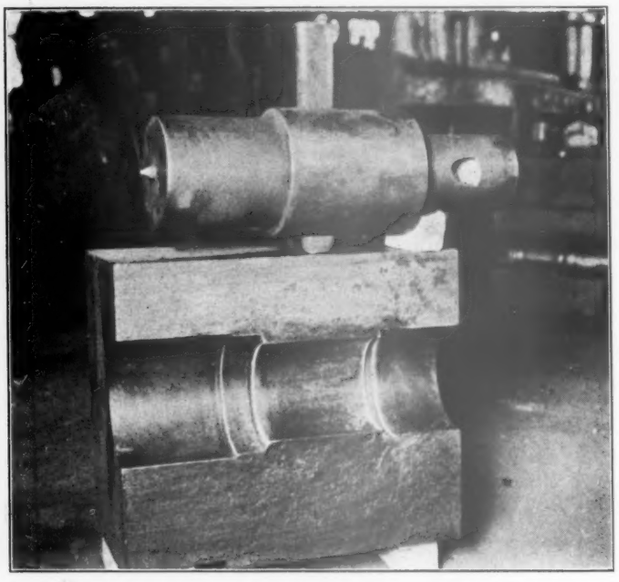


Forging Machine with Special Backstop for Reclaiming Axles.

The reforming of the axles is a job requiring special equipment. Where a forging machine of sufficient capacity is available the work can be done quickly and cheaply. About two years ago the Atchison, Topeka & Santa Fe fitted up a forging machine at its Topeka shop for doing this work and has reclaimed several thousand axles. The first operation in reclaiming the axle is to heat one end in a furnace and draw it down under a steam hammer from the center to the collar on the wheel seat to increase the distance between the inside fillets on the journals. The collar on the journal is also broken down with swedges in this operation. Each end of the axle is lengthened about one-fourth to one-half inch in this way. After this a short heat is taken on each end of the axle and it is upset in a 6-in. Ajax forging machine. The machine in which this work is done has a special backstop which insures the axles being made to the proper length. About 1/8-in. is left at each end to be turned off in the lathe and the collar is made about 3/8-in. over size. To take care of any surplus stock on the axle, a groove is provided in the die at the end of the collar into which the extra metal is forced when the axle is upset. After the forging work is finished the axles are placed in a furnace and thoroughly annealed to restore the proper structure in the metal. This is an essential part of the work, as it has been found that axles taken from service, though apparently in good condition, often will not pass the M. C. B. drop test due to fatigue and crystallization. Axles which have been reformed by the process described above and properly annealed are superior to new axles as the increased diameter at the center gives them additional strength.

The work of reclaiming axles cannot be handled satisfactorily on a forging machine of less than 6-in. capacity. There are few railroad shops that have such large machines available, but the savings effected are so great that roads having a considerable number of cars would find it economical to install machines for this work alone. At the present time

the cost of a new 5-in. by 9-in. axle is about $35.60. The scrap value of a 5½-in. by 10-in. axle is $17.30 and the cost of reclaiming it in the forging machine is $1. Thus, for each 5½-in. by 10-in. axle made into a 5-in. by 9-in. axle there is a saving of $17.30. The savings effected by reclaiming 5-in. by 9-in. and 4¼-in. by 8-in. axles are $12.80 and $8.55, respectively. During the first eleven months in which the forging machine at Topeka was in use there were reclaimed 1,120 5½-in. by 10-in., 1,427 5-in. by 9-in., and



Dies Used for Forming the Ends of the Axles

1,589 4¼-in. by 8-in. axles. The savings effected amount to more than $40,000, although the machine was in use only a part of the time on this work.

STEEL CAR SILL STRAIGHTENER

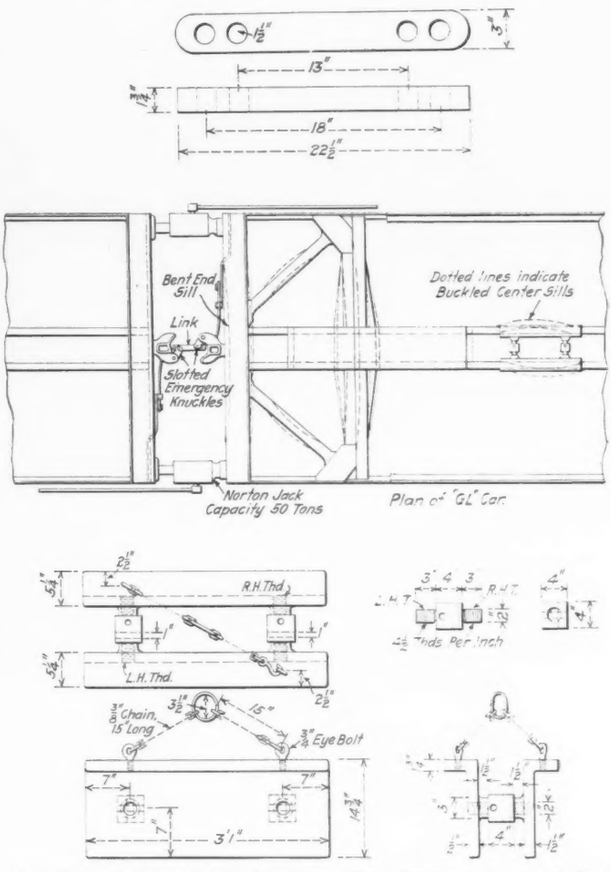
BY E. A. M.

The ordinary method of straightening center sills, end sills, bolsters and the diagonal braces of steel gondola freight cars consists in taking the sills apart, straightening them separately and reassembling. This process is expensive and requires considerable time. In many cases the following method may be used to good advantage. Referring to the illustration, the dotted lines indicate in a general way the position and shape of sills after they become bent, due to excessive buffing shocks or other mistreatment. The center sills, running lengthwise of the car, usually buckle as shown, and the end sill is bent back at the center. If the bent sills can be heated and a strain brought on the drawbar all the sills may be straightened at once with the aid of a little sledging.

The device shown between the center sills consists of two inverted L-shaped castings. They are 10 in. in width between the vertical sides when closed and can be spread to 15 in., or whatever the distance is between center sills by means of the turnbuckle indicated. The flange on top holds the device in position in addition to providing a means of lifting it in and out of place.

The damaged car is coupled to another car by means of the link and two 50-ton hydraulic jacks are placed between the cars. All bent parts are heated simultaneously by two or three men using oil burners, and when not enough, a man operates each jack, thus tending to increase the distance between the cars and thereby pull the bent parts straight. A little sledging is usually necessary, especially on the center sills, and if the device shown between the sills is set properly the operator simply sledges the bent sill until it is in place.

This operation is now done 35 to 40 per cent cheaper than



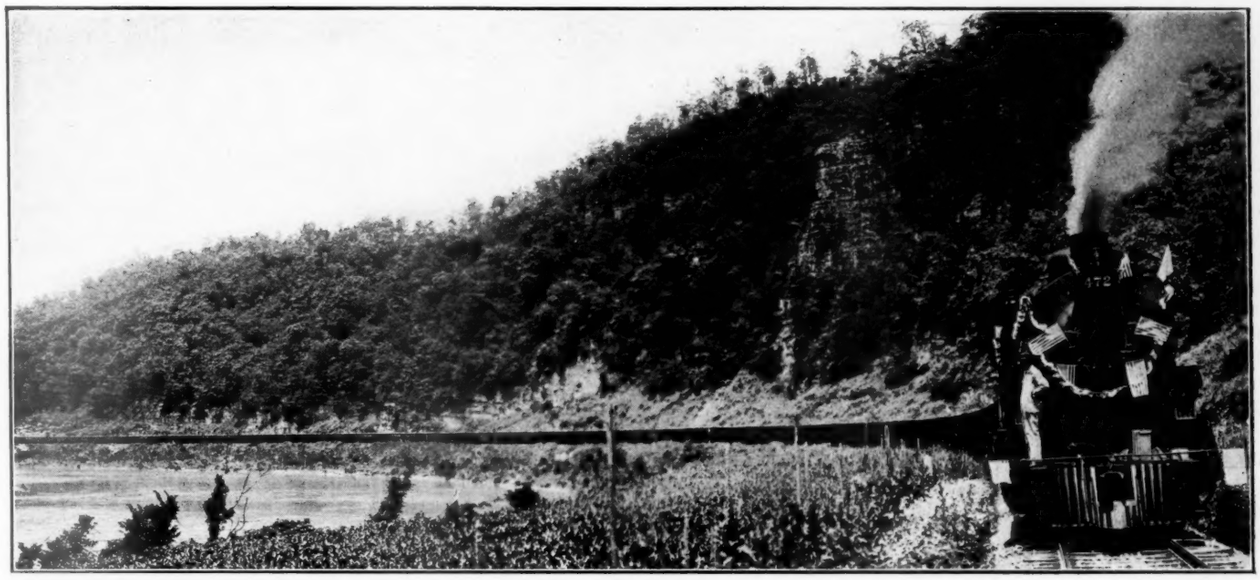
Method of Straightening Steel Car Sills Without Removal from the Car

by the older method of taking everything apart, straightening the parts separately and reassembling. In addition to the saving in cost there is a material saving in time and the car is returned to service quicker.

In case the center sill shows evidence of weakness or a crack starts in straightening, it may be reinforced locally.

Hydrogen as a Substitute for Petrol.—To replace the shortage of petrol in Switzerland, pure hydrogen has been experimented with for some time, says the Commercial Motor. Hydrogen, as is well known, is the richest combustible gas and contains practically double the calorific values of petrol. The main drawback of hydrogen is its weak density, which necessitates a considerably higher compression as compared with coal gas in containers.

The French Equipment Problem.—Of the 376,000 cars available on the French railways in August, 1914, 55,000 were lost to the railways, presumably as the result of enemy occupation of territory, says an article in a recent issue of the Industrial et Commercial Français. Even with the addition of the vehicles provided by the British authorities, an assistance which is described as invaluable, the total rolling stock available has been inadequate to meet all demands, and with the utmost relief which can be obtained by the utilization of highways and inland navigations, it is held that the traffic needs the construction of more than the 33,000 cars.



Automatic Straight Air Brake Test Train of 100 Cars on the Virginian Railway

ROAD TESTS OF THE A. S. A. BRAKE

100 Car Train Run on Virginian with A. S. A. and Combinations of A. S. A. and Westinghouse Brakes

ON July 4, 1918, a train of 100 loaded coal cars having a gross weight, exclusive of the locomotive and caboose, of about 7,600 tons, equipped throughout with Automatic Straight Air brakes, was run over the Virginian Railway from Princeton, W. Va., to Roanoke, Va. This train was run as the last of a long series of tests, including both rack and road tests, which have been conducted by the Bureau of Safety of the Interstate Commerce Commission to determine the practicability of the Automatic Straight Air brake system, controlled by the Automatic Straight Air Brake Company, New York. Following the 97-mile run from Princeton to Roanoke, the Automatic Straight Air brake equipment on fifty cars was replaced with the Westinghouse equipment generally in use on the class of cars of which the train was made up. The train, thus equipped, was run from Roanoke to Victoria, Va., a distance of 123 miles, with the A. S. A. equipment at the head of the train and the Westinghouse at the rear, and from Victoria to Sewalls Point (Norfolk), Va., 120 miles, with the Westinghouse equipped cars at the head of the train and the A. S. A. cars at the rear.

The test train was made up of 100 52½-ton hopper coal cars averaging about 41,600 lb. light weight, a Mikado type locomotive and a caboose chronograph car. Helper service was available throughout the trips over the Third and Second divisions, but the helper locomotive had no part in the brake operations. The cars are regularly fitted with Westinghouse 10-in. freight brake equipment, including K-2 triple valves.

FUNCTIONS OF THE A. S. A. BRAKE

The Automatic Straight Air Brake car equipment of the type with which the train was fitted, consists of a triple valve with separate service and emergency sections, and a change-over valve.* In addition to the usual type of brake cylinder and auxiliary reservoir, the equipment includes a service reservoir which during service operations is in effect a part of the train pipe, providing the necessary train line volume from which to furnish air for service applications. The engine equipment consists of a high volume feed valve and a compensating valve. The former performs the same functions as and replaces the slide valve feed valve, while the latter replaces the equalizing discharge valve of the engineer's brake valve, and in addition to performing the functions of that valve, automatically maintains train pipe pressure while the brake valve is in lap position, at whatever point was established by the preceding position of the valve.

Essentially the functions of the Automatic Straight Air brake equipment are as follow:

(1) Rapid serial action in service applications and in quick release.

(2) The maintenance of uniform and constant brake cylinder pressure, irrespective of piston travel or cylinder leakage. The cylinder is fed from the brake pipe, the pressure in which in turn is maintained by the compensating valve while the brake valve is in lap position.

(3) Graduated release, permitting a variation of brake cylinder pressure at the will of the engineman.

(4) Quick release when desired.

(5) Emergency applications of the brake available at any time during or after any service application, and an automatic emergency application on full depletion of train pipe pressure.

PURPOSE OF THE TESTS

The purpose of the three 100-car test runs, the first of which was made on July 4, was, first, to demonstrate the ability of the A. S. A. equipment to handle the longest trains ordinarily operated under any conditions, down long heavy grades, and, second, to determine the ability of the A. S. A. equipment to operate successfully when combined in trains, including brakes of existing types. The train was equipped for the collection of complete data as to the performance of the brakes on practically every car, each car, with one ex-

*For a complete description of the three-unit type A. S. A. car equipment (the type with which the test train was equipped), see the *Railway Mechanical Engineer* for November, 1917, page 633.

ception, being fitted with a trainagraph, recording brake pipe, auxiliary reservoir and brake cylinder pressure. A chronograph in the caboose provided a continuous chart on which was recorded the time of each brake valve movement, the time of application and release of the brakes on the first, fiftieth and one-hundredth cars, and the usual data as to speed, mileposts, etc. In addition to the trainagraph record of brake valve movements, constant telephone communication was maintained between the locomotive and the caboose. The locomotive and chronograph car each was equipped with a speed recorder. In addition to the equipment for the observation of brake conditions, pyrometer connections were made through slip rings on the axle to the rim, plate and hub of one of the rear wheels on the one-hundredth car, as well as to the brake shoe, from which temperature observations were taken during periods of heavy braking.

To demonstrate the characteristics of the Automatic Straight Air Brake for heavy grade work, the First division of the Virginian Railway from Princeton, W. Va., to Roanoke, Va., was chosen. Beginning at a point about two miles east of Princeton is a 1.5 per cent compensated grade, nearly 11 miles long, ending at Kellysville, which, from the standpoint of braking conditions, is the greatest obstacle imposed in the way of loaded train movement. The length of trains operated down this grade is limited to a maximum of 85 loaded cars. The uncertainty of the control of the brakes throughout the train has made impracticable the successful operation of longer trains.

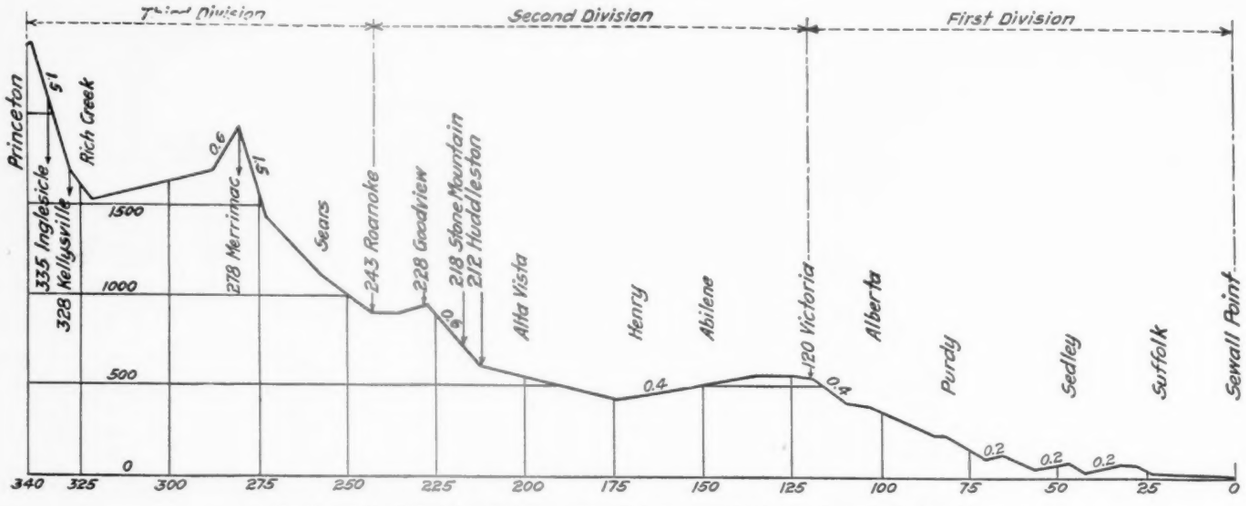
From Kellysville east for about two miles the grade is slightly ascending, followed by about four miles of .8 per cent descending grade. From Rich Creek this grade is followed by about 43 miles of light ascending grade, most of which does not exceed .2 per cent. Succeeding this is another 1.5 per cent descending grade. This one, however, does not exceed seven miles in length and offers less difficulty in train control than Kellysville hill. The remainder of the First division is made up of a broken light, eastbound descending grade and offers little of interest from the standpoint of brake operation.

From Princeton to Kellysville the cars were all operated in graduated release, and 90-lb. train line and 110-lb. main reservoir pressure were maintained, in accordance with the practice of the road. When operating in quick release position the Automatic Straight Air brake equipment provides the engineman with direct control of the brake cylinder pressure throughout the train. With the train so equipped, instead of resorting to the cycling method of brake operation practiced with existing types of equipment, brake cylinder pressure once established, need never be fully released as long as a retarding force is required. On the basis of a braking power of 60 per cent of the light weight of the cars at 50 lb. brake cylinder pressure, an average co-efficient of brake shoe friction of 20 per cent and a train resistance of about 3.5 lb. per ton, a rough calculation indicates that a uniform speed of 15 miles an hour should be maintained down a 1.5 per cent grade with a constant cylinder pressure of 20 lb. The schedule of the test run down Kellysville hill, therefore, called for the maintenance of approximately 20 lb. cylinder pressure, that is, a 10-lb. brake pipe reduction, to be slightly raised or lowered by the manipulation of the brake valve between lap and running positions, and lap and application positions, as the speed of the train seemed to require.

EVENTFUL RUN DOWN KELLYSVILLE HILL

Three incidents interfered with the strict following out of this plan during the first three and one-half miles down the hill. At the first application of the brakes an unnecessarily large brake pipe reduction was made and held too long, with the result that the train was stopped after having proceeded about one and one-half miles from the top of the grade. During this stop a maximum cylinder pressure of 32 lb. was recorded on the last car. The brakes were released and the train started in about eight minutes after the stop and about one minute later, when the speed had attained 11 miles per hour, an emergency application was effected by the blowing off of a hose on the rear end of the ninety-fourth car. This occurred just after a 10-lb. brake pipe reduction had been made on the engine; nevertheless, the emergency action was effective throughout the length of the train, which came to a stop without noticeable shock at either end. Following this incident, five minutes after the train had again been started, the train parted between the eighty-fourth and eighty-fifth cars, due to the slipping by vertically of the coupler knuckles. This occurred about four minutes after a brake pipe reduction of approximately 10 lb. had been made, and again the emergency application of the brakes brought both ends of the train to a smooth stop about 125 ft. apart.

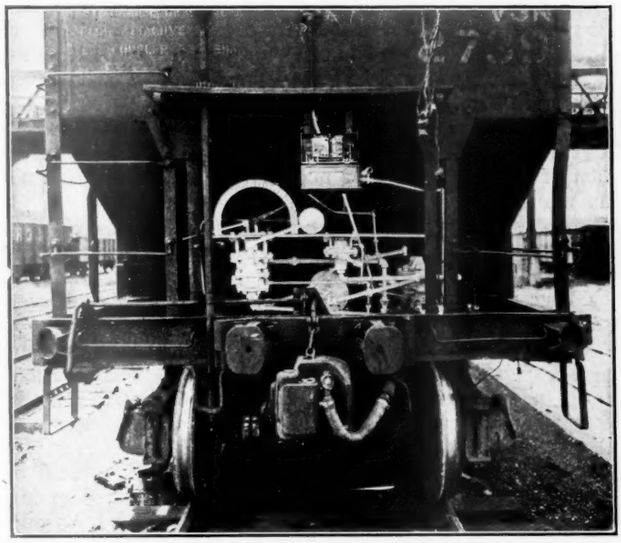
The remaining eight miles of the grade, from Ingleside to Kellysville, were traversed in 30 minutes, without incident. From the time the brakes were applied after the train was started until the final stop in Kellysville yards, the brakes were never fully released. The brake cylinder pressure on the hundredth car varied up and down between 10 and 30 lb.



Profile of the Virginian Railway from Princeton, W. Va., to Sewalls Point, Va.

and with a few exceptions which were of only short duration the speed variations were between 14 and 21 miles an hour.

During the run ending with the stop at Kellysville, pyrometer readings of wheel temperatures on the one-hundredth car showed a maximum temperature of 280 deg. F. in the rim, 190 deg. in the plate and no rise in temperature in the hub of the wheel; the maximum temperature of the brake shoe was 670 deg. F. These maximums were reached as the train stopped at Kellysville. Examination of the wheels on the rear half of the train indicated a high degree of uniformity in temperature. That the same condition applied generally throughout the train is well indicated by the aver-



The Rear End of the One-Hundredth Car, Showing the A. S. A. Brake Equipment and the Trainagraph

age cylinder pressures maintained during the run from Ingleside to Kellysville. Following the test, the trainagraph records of cars 1, 25, 50, 75 and 100 were removed and the average cylinder pressures obtained by planimeter measurements. These averages were: Car 1, 24.88 lb.; car 25, 24.4 lb.; car 50, 21.36 lb.; car 75, 25.84 lb., and car 100, 16.56 lb., an average of 21.81 lb.

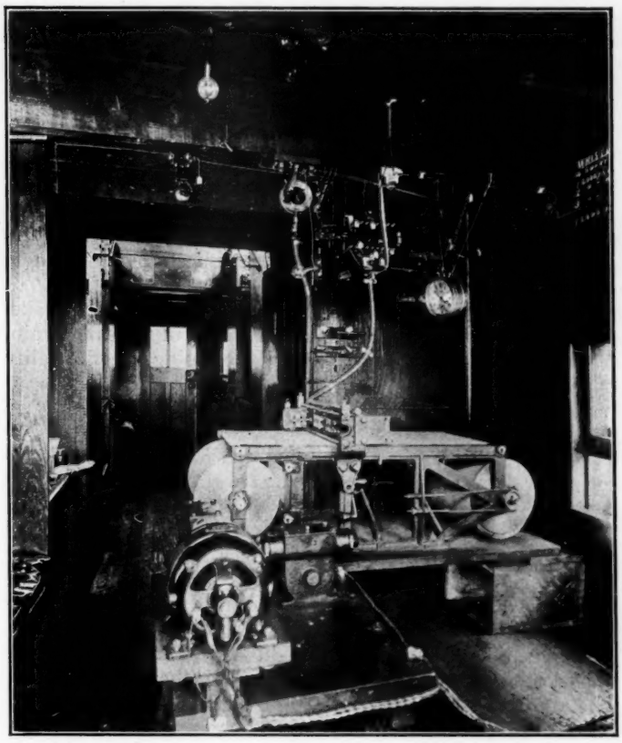
At Kellysville the brakes on the last 50 cars were changed from graduated release to quick release, under which conditions the train ran down the four-mile .8 per cent grade. Twice during this part of the run the train broke in two, in both cases immediately following the release of the brakes after service applications. In the first instance a knuckle pin was sheared and in the second a knuckle was broken. The broken section of the knuckle, while largely a new break, showed a flaw in the casting which may have contributed to its failure. It is worthy of note, however, that in neither case was the parting of the train preceded by a shock of any severity. In both cases the train was brought to a smooth stop.

PERFORMANCE OF MIXED EQUIPMENT

At Roanoke the A. S. A. brake equipments were replaced with the Westinghouse K-2 triple valves, on one-half of the cars in the train. Following the completion of this work, on July 8 a run was made over the Second division from Roanoke to Victoria, Va., with 49 A. S. A. cars at the head end of the train, followed by 50 Westinghouse cars and one A. S. A. car at the rear of the train. The entire 50 cars with the A. S. A. equipment were operated in graduated release.

The Second division is characterized by a gradually descending profile for the first half of the distance, the maximum grade being .6 per cent descending eastbound. The longest descent of this gradient begins about two miles east of Goodview and with the exception of the fourth mile, in which the grade is reduced to .1 per cent, this descent is continuous for 13 miles, ending about one mile west of Huddleston. The remainder of the grades are light and short and require very little braking. The practice on this, as well as on the First division, is to maintain 70 lb. train line and 90 lb. main reservoir pressure, and this practice was followed in the test.

An average speed of 20 miles an hour was maintained down the long .6 per cent grade east of Goodview with very little variation. The maximum variation occurred when the speed reached 30 miles an hour, just preceding the stop at Stone Mountain, which is located eight miles east of the top of the grade. On the run from Stone Mountain to Huddleston an average speed of 20 miles an hour was maintained with a maximum variation of not more than two miles an hour. The train was handled on this grade by the one application method, the brake cylinder pressure on the first 49 A. S. A. cars being graduated up or down as



Interior of the Chronograph Car

conditions required. During this period some of the Westinghouse brakes applied and leaked off, but at no time during this run was there an application of the brakes on the one-hundredth car until the heavy train pipe reduction made just preceding the stop at Huddleston.

The run over the last half of the Second division was made with the first 25 A. S. A. cars in graduated release and the remainder in quick release, the brakes being manipulated in the usual manner. Following this change in the operation of equipment, two water stops were made without shock at the rear end of the train.

At Victoria the 50 Westinghouse cars were placed at the head of the train, with the 50 Automatic Straight Air brake cars at the rear, all being placed in quick release. On July 9

the train was run from Victoria to Sewalls Point, Va., over the First division, a distance of 120 miles.

This division is characterized by light rolling grades with an aggregate eastbound descent of about 500 ft. in the first 63 miles. Although the maximum grade is .6 per cent, considerable difficulty has been experienced in properly controlling the speed of long trains because of the broken nature of the grades. In the operation of 100-car loaded trains, which are regularly handled over this division, practically no braking is done to control the speed of the train. In order to insure the application and release of all brakes in the train, such a heavy brake pipe reduction is required that it is practically impossible to make an application without bringing the train to a full stop. It is the practice to let the trains run, which at many points results in the attainment of undesirably high speeds before the speed is checked by a change in the grade.

During the test run several brake applications were made to control the speed, the reductions ranging from 5 lb. to 14 lb. In every case the brakes applied on the one-hundredth car and the smoothness with which the train was handled indicated a uniformity of brake application throughout the train. In one case a break-in-two resulted from an attempt to release without sufficient time in full release position, the brake valve being returned to running position after a period of only nine seconds in release. Following the customary practice with the A. S. A. brake, however, in which the valve is maintained in full release position for not less than 25 seconds, no difficulty was experienced in releasing the brakes throughout the train. The release on the one-hundredth car was obtained in 35 seconds from the time the brake valve was placed in release position, following a 5-lb. train pipe reduction. In fact, there appeared to be no appreciable difference in the time required to effect the release of the brakes on the last car, irrespective of the extent of the train pipe reduction.

It seems evident that the Automatic Straight Air brake, even when operating with other equipment in the same train, offers the possibility of materially increasing the flexibility of train control.

ADVANTAGES DEMONSTRATED BY THE TESTS

Undoubtedly the most important consideration in estimating the value of any device having to do with train control is the degree of safety of train operation attending its use. A braking system to be highly successful must be capable of retaining the train constantly under a control which not only provides against the loss of life, but also protects the equipment and lading in the train from damage in the face of any situation which reasonably may be expected to arise. The value of the Automatic Straight Air brake in this respect was demonstrated several times during the 100-car tests. The attainment of emergency applications of the brakes and smooth stops of this long train when operating at slow speeds, ranging from 11 to 14 miles an hour, in one case immediately following a brake pipe reduction and in another immediately following a release of the brakes, demonstrates the value of the reserve emergency braking power which is always available with the Automatic Straight Air brake equipment. This function of the A. S. A. Brake was strikingly demonstrated during a standing test preceding the run of July 4. Following a release after a full service application, with the brakes operating in quick release, the brake valve was moved immediately from the release to the emergency position. The brakes toward the front of the train had fully released before the emergency started, and an examination of the trainagraph records showed that the emergency action overtook the release at the 73rd car. The emergency action on the remainder of the cars was not preceded by a release of the service application.

Lack of control immediately following a release from a service application is a frequent cause of accidents under such conditions, for instance, as entering a yard in a fog, or an unexpected change in signal indications.

One of the serious difficulties encountered in the operation of heavy trains down long steep gradients is the excessive temperatures produced in the wheels and brake shoes. This is due to two causes: First, the inequality of braking efforts obtained throughout the length of a long train, resulting in the conversion of an excessive amount of energy at the wheels of the cars toward the front of the train and, second, due to the comparatively short time available for the conversion and dissipation of the heat generated under the cycling method of brake operation. It is evident that given the same weight of train and average rate of speed, the aggregate amount of energy which must be converted into heat and dissipated remains the same, irrespective of the method of brake manipulation. The nearer uniform the speed remains, however, the lower will be the maximum rate of heat conversion and, therefore, the lower the temperature is maintained in the wheels and brake shoes. Brake burned wheel treads and excessive brake shoe wear are responsible for the destruction of a large amount of material from which is obtained no return in service performed.

The ability to control with certainty under all conditions the maximum trains which may otherwise be operated, removes a limitation to transportation capacity often imposed by long, heavy grades, which otherwise can only be overcome by an extension of facilities.

Another matter worthy of careful consideration is the demands of the brake system on the air pump. With the long trains now operated the quantity of free air which must be compressed is enormous under the best of conditions and the air pump draws heavily on the coal pile. The saving of air effected by the method of braking demonstrated on Kellysville hill is evident. The pump was required to furnish only the air needed to maintain the desired cylinder pressure against train line and cylinder leakage and the comparatively small amount released from the cylinders when reductions of brake cylinder pressure were necessary. This is obviously much less than is required repeatedly to recharge the system following full releases of brake cylinder pressure at from two to three minute intervals with the cycling method of brake operation. When operating in quick release this advantage is lost and the saving in air consumption with the A. S. A. brake is not so pronounced. That there is a saving, however, is evident from a comparison of the volumes which must be recharged following full release after a service application. The service reservoir, which, together with the train line, supplies the brake cylinder, has a volume of 2,100 cu. in. for 10-in. equipment, as compared with 2,800 cu. in. in the auxiliary reservoir, the air in which is not drawn upon during service applications. This difference in volume indicates the extent to which air from the train line is utilized in the brake cylinders.

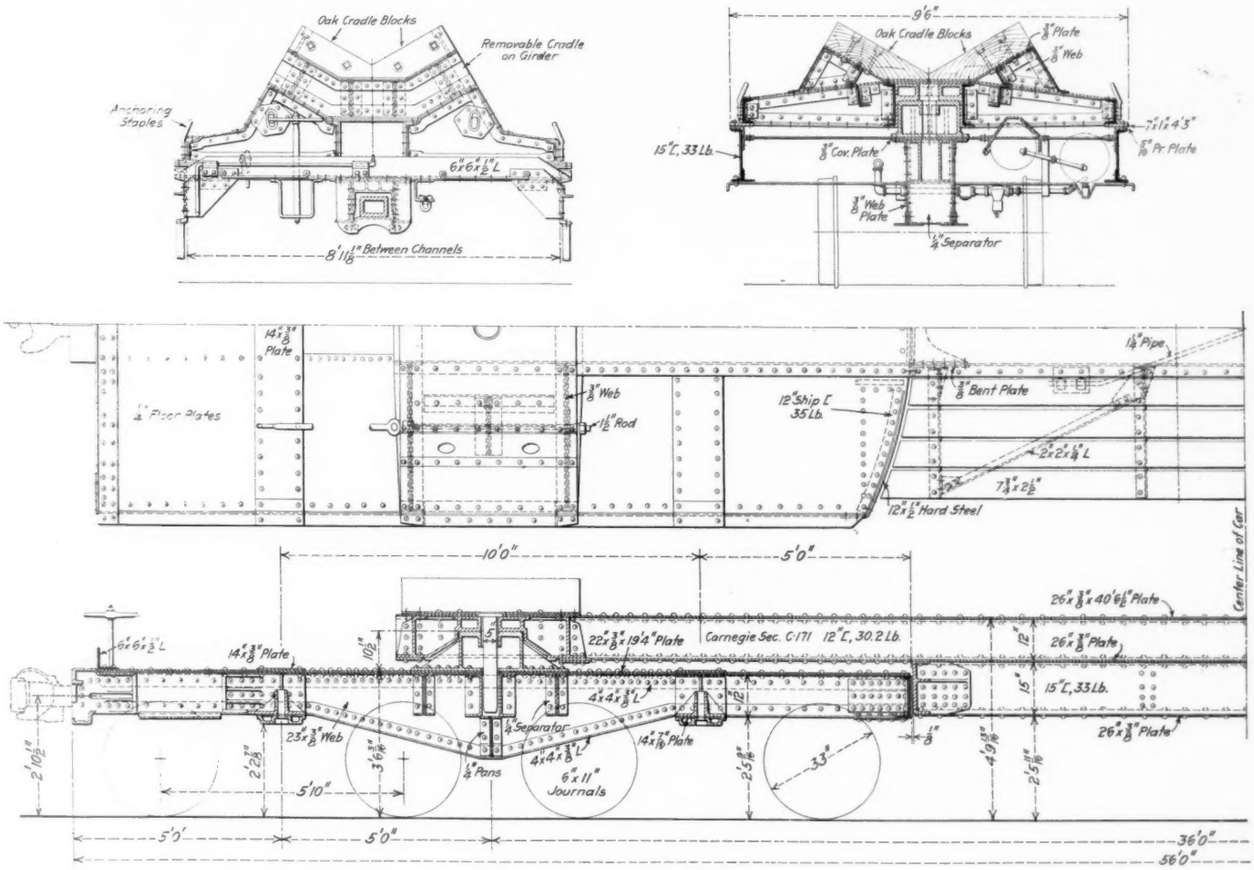
After a study of the performance of the brakes on the 100-car test trips it seems evident that the Automatic Straight Air Brake performs the functions for which it was designed under everyday service conditions. The economic value of the practical application of these functions it would be difficult to overestimate.

Fusee Powder in a Hot Box.—A fusee is a mighty dangerous thing to pack a hot box with. This is the text of a circular which has been issued by the safety engineer of the Grand Trunk, to tell of an engineman and a brakeman who used powder taken from fusees to cool hot journals. This is characterized as the latest fashion in getting hurt, a fashion which all employees in Canada are reminded to steer clear of. A fusee contains potassium perchlorate, sulphur, charcoal and a lot of other things that do not get along well together in a hot box.

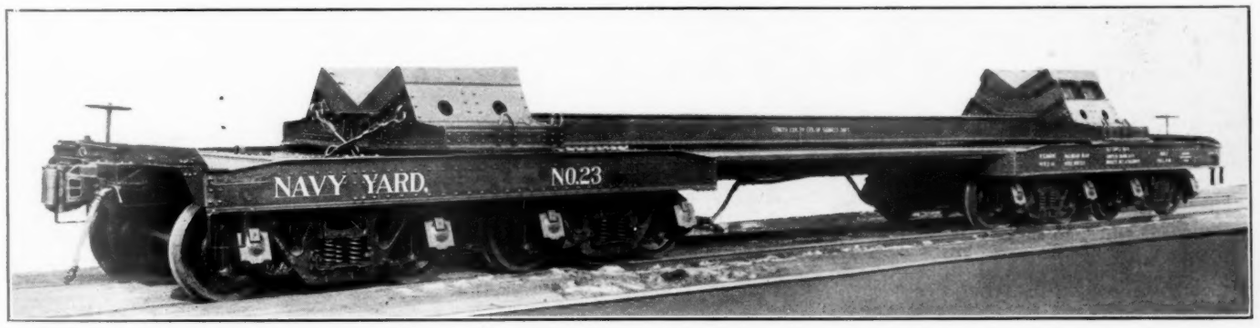
GUN TRANSPORT CAR FOR THE NAVY

The movement of big guns by rail requires special equipment, which often involves interesting features of construction. A typical example is found in the gun transport car recently delivered to the Navy Department by the Pullman Company. This car is intended to be used for the transportation of the unmounted barrels of navy guns. It is designed to handle 16-in. guns, which are 68 ft. long and weigh 286,135 lb., but can also be used for smaller guns. An idler is required when handling 16-in. and 14-in. guns, but smaller guns do not project beyond the ends of the car. The design of the car permits operation over curves as sharp as 100 ft. radius.

The weight of the car complete is 81,000 lb. and the length over the striking castings is 56 ft. When carrying a 16-in. gun the total weight at the breech end will be 165,317 lb. The complete car consists essentially of two flat cars of special design with a bridge placed on them which is arranged to carry the load. The two flat cars on which the bridge is carried are mounted on 70-ton trucks, spaced 10 ft. from center to center. The cars are designed to perform two functions, first to carry the load placed on the auxiliary center plate in the center of the car, and second to transmit the buffing and pulling stresses to the bridge. The center sills are of the fishbelly type 24½ in. deep at the center and 12 in. deep at the bolster, made up of two ⅜-in. web plates. Each web plate has the bottom edge reinforced with two 4-in. by 4-in. by ⅜-in. angles, while at the top edge there is a single angle on the outside of each plate. A cover plate ⅜



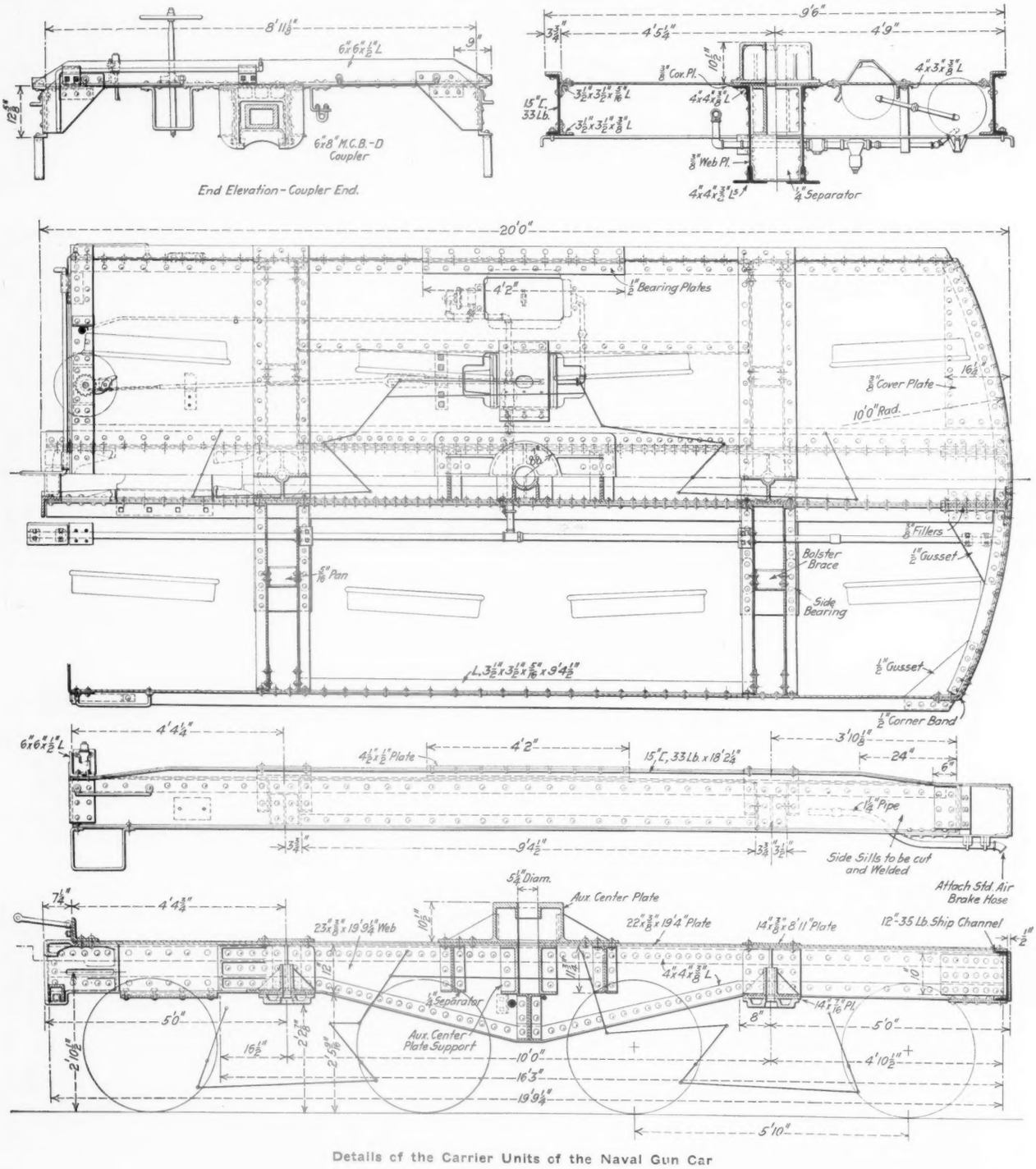
Plan and Elevation of Naval Gun Car



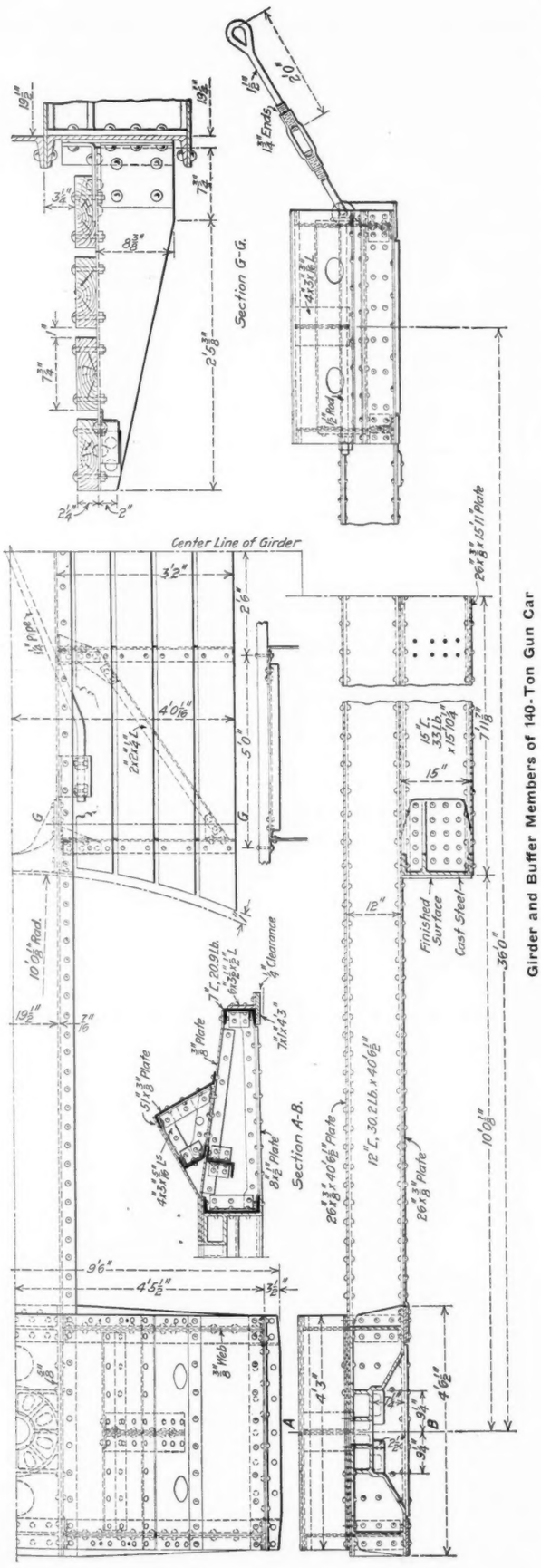
Special Car Designed to Carry 16-Inch Guns

in. thick and 22 in. wide extends the entire length of the car. Between the sills at the center of the car there are two pressed steel separators placed back to back. Between these and the cover plate is the auxiliary center plate support. The auxiliary center plate rests on the cover plate and is further supported on the ends by separators between the web plates. The bolsters are made up of two pressed steel pans spaced 7 in. apart, with fillers above the side bearing, and top and bottom cover plates.

The outer end of the center sill carries the usual draft gear and has a straight end sill. The inner end is arranged to transmit the buffing forces to the bridge and the end sill is in the form of an arc of a circle concentric with the auxiliary center plate. This curved end sill is a 12-in., 35-lb. ship channel reinforced by a cover plate and faced on the outer surface with a ½-in. by 12-in. spring steel plate. The end sill is fastened on either side to 15-in., 33-lb. channels, which form the side sills. An angle iron 2⅝ in. from the top flange forms the support for the deck, which is made of checkered steel plate. Between the bolsters, the side sills are



Details of the Carrier Units of the Naval Gun Car



further reinforced by an angle iron along the bottom edge.

The bridge has a large steel casting on each end, which fits over the auxiliary center plate. These center castings are spaced 36 ft. from center to center and are joined by a girder made up of two 12-in., 30.2-lb. channels spaced 19 in. apart with the top and bottom cover plates 26 in. wide and ⅜ in. thick. Under the center portion of the girder is a buffing member which is in line with the underframes of the flat cars. The buffer member consists of two 15-in., 33-lb. channels with a bottom cover plate ⅜ in. thick. At each end of the channels there is a buffer casting which is curved to fit the end sills of the flat car. The lower buffer member carries four brackets on each side, which serve as supports for running boards. The buffer member is designed to remove the buffing stresses from the upper girders and the center plate, and to insure that the stresses will be transmitted to the lower member the auxiliary center plates are given a longitudinal clearance of ½ in. in the center castings.

The end of the girder member carries two cradles which extend to the side sills and resist the tendency of the bridge to tilt. The center portion is formed of a V-shaped cradle in which the gun rests. At the end which carries the breech, heavy timbers are used for blocking. At the muzzle end, where the support must be higher than at the breech, a removable cradle built up of structural steel is provided. Two 1½-in. eye bolts pass through each cradle and provide a means for fastening the gun to prevent any longitudinal movement.

Each of the two flat cars has a separate braking system and the train line is carried under the buffing member and connected to the trucks by the usual standard M. C. B. air hose.

INSTRUCTIONS RELATING TO CAR REPAIRS

The Committee on Standards for Cars and Locomotives at its meeting at Washington the latter part of the month decided upon a plan for fixing a maximum amount which is not to be exceeded in making repairs to freight cars, depending upon the age, type and class of cars. Freight cars in need of general repairs will be thoroughly inspected, all defective parts noted and an estimate made showing the cost to place the car in general condition for two years' service, barring accident and running repairs. A circular will be issued by the division of operation prescribing the limits of cost for making repairs approximately as follows:

Wooden freight cars which have not been rebuilt and improved by application of metal draft arms extending beyond body bolster, continuous steel draft arms, steel center sills or steel underframe:

(A) In service 20 years or more:

All freight cars	Limit of cost of repairs in kind, labor and material
If equipped with 40,000 lb. capacity trucks or less.....	$25
Over 40,000 lb., but less than 60,000 lb. capacity.....	75
60,000 lb. capacity trucks and over.....	100

(B) Cars in service 10 years and less than 20 years:

	Limit cost of repairs			
	In kind		With betterments	
	All cars except refrg.	Refrg.	All cars except refrg.	Refrg.
Equipped with 40,000 lb. capacity trucks or less.....	$25	$100	No Betterments to be applied	No Betterments to be applied
Over 40,000 lb., but less than 60,000 lb. capacity.....	100	150		
60,000 lb. capacity and over.	150	500	$1,000	$1,200

Cars in service over 5 years and less than 10 years, and cars found equipped with metal draft arms extending beyond body bolster, continuous steel draft arms, transom draft gear, steel center sills or all steel underframe:

All cars, having trucks 60,000 lb. capacity and over, will

be repaired unless total cost of repairs, including cost of betterments, plus scrap value, exceeds 75 per cent of the value of a new car.

If cost of repairs exceeds 75 per cent of the value of a new car, it will be dismantled and good parts reclaimed for use in repairing cars of similar types. This will apply to existing equipment *only*.

Cars in service 5 years and less:

All cars, having trucks 60,000 lb. capacity and over will be thoroughly repaired at cost necessary.

Cost of application of safety appliances, wheels, journal bearings and couplers will not be considered in the estimate of the cost of repairs.

All wooden freight cars with trucks of 60,000 lb. capacity and over receiving general repairs, not equipped with metal draft arm extending beyond body bolster, steel draft arms extending full length of car, steel center sills or steel underframe, will be equipped. Where equipped with steel center sills, a continuous cover plate will be riveted to the top of the sills.

When cost of repairs in kind exceeds the amount allotted to be expended and betterments are not to be applied, the car will be dismantled. Should cost of repairs in kind exceed the amount allotted and betterments are to be applied, if material is not available car may be sent to owners.

When cars are dismantled or sent home to owners for rebuilding a detailed statement will be made showing the estimated cost of repairs in kind by items, and forwarded to owners showing disposition, and copy retained by handling company.

To estimate the detailed cost of repairs 35 per cent should be added to the sum of applied labor and material.

STANDARDIZATION OF PASSENGER CARS

Plans for the standardization of passenger coaches and baggage cars were also discussed at the meeting of the mechanical committee, and subcommittees were appointed for the purpose of reporting on proposed designs. Individual members of the committees were assigned various phases of the designs for study to be reported at the meeting of the committee next month and recommendations will be made as to proposed standard dimensions. A sub-committee was also appointed to investigate the subject of driving-boxes for locomotives.

REGIONAL INSTRUCTIONS

The matter of car repairs has also received the attention of the regional directors. During July the following circulars relating to car repairs were among those issued in the western regions.

Car Repair Shops.—In circular No. 20, dated July 13, B. F. Bush, regional director of the Southwestern region, called attention to the fact that some roads are working their car repair shops less than 60 hours per week and quoted from a letter from Frank McManamy, assistant director, mechanical department, division of operation, instructing that the hours of freight car repair on all lines and in all shops where work can be furnished them shuold be increased to 60 hours per week and more if practicable.

Building Refrigerator Cars in Company Shops.—In inquiry No. 2, dated July 9, the regional director of northwestern railroads asked the lines in his territory to advise him of the number of refrigerator cars that can be built and rebuilt at each of their shops without interfering with other necessary car repair work.

Cars With Short Draft Timbers.—In inquiry No. 1, dated July 9, the regional director of northwestern railroads asked the lines under his jurisdiction to advise him of the number of wooden cars owned by each road which are equipped with draft timbers extending only to the body bolster, secured to draft sills by bolts, showing the total number, separated by class and capacity. If arrangements have been made to dispense with the use of such draft timbers the roads were asked to advise what will be substituted for them.

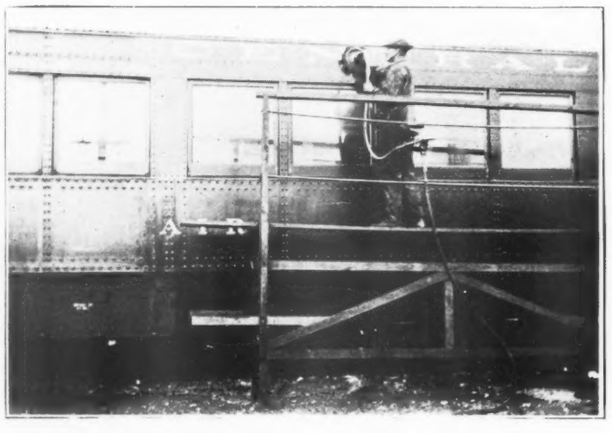
Cars Damaged by Switching.—The regional director of central western railroads has quoted a letter from the Car Repair Section of the division of operation of the Railroad Administration, which points out that an increasing number of freight cars are being damaged by switching crews, and urges that special men be placed in transportation yards to check up the rough handling of equipment in order to place responsibility so that necessary corrective measures may be taken. By reducing the number of damaged cars in switching yards a reduction is effected in the number of cars placed on shop tracks, thereby assisting materially in making men available for repairs to equipment becoming defective from other causes and making more cars available for service. The regional director asked that the lines under his jurisdiction take the steps suggested by the Car Repair section of the Railroad Administration.

Responsibility for Car Repairs.—The following instructions have been sent out by the regional directors in the various regions:

Each railroad is responsible for the condition of all cars on its lines, and must give to all equal care as to inspection and repairs. When material standard to the car is not readily obtainable, suitable material of equal strength that is not standard to the car may be used, and the use of such non-standard material will not constitute wrong repairs. When using such material, changes that will prevent standard material from being used in future repairs should be avoided as far as practicable. Railroads are responsible for damage done by unfair usage, derailment or accident to any car they handle, and must make proper repairs at their own expense.

CUTTING THE COST OF EXTERIOR CAR CLEANING

The periodical scrubbing of cars which is necessary in order to take off the dirt that cannot be removed by ordinary washing, is usually done by hand. Even where the best facilities are provided the work is tedious and the operation is expensive. With a view to reducing the cost of this work, the Illinois Central recently made some experiments in the use of power driven brushes. The methods which have been developed have resulted in a reduction of 50 per cent in the cost of cleaning cars as compared with the cost under the former practice.

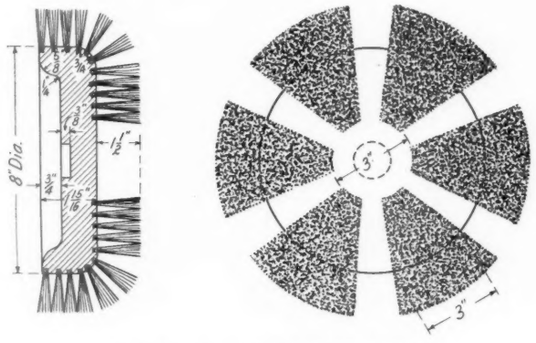


Cleaning Letter Board with Power Driven Brush

The illustrations accompanying this article show clearly the method of using the device. The first experiments were

made with a circular brush attached directly to a small reversible air motor. On account of the weight of the machine, the brush was hard to handle and the operator soon became tired. Counterweights were tried, but proved clumsy and inconvenient. It was then decided to try a flexible shaft and since a shaft was procured that would transmit power when driven in either direction the results obtained have been very satisfactory.

The arrangement in use at present consists of an air motor arranged so that it can be suspended from a horizontal rod on a scaffold and attached to a round brush by a flexible shaft about six feet long. The air motor used on this work is the Thor B W type with special gearing, arranged to run at a speed of about 900 revolutions per minute. It is essential that a reversing motor be used as it prolongs the life of the brush very greatly. It would probably be better to have the brush driven at somewhat higher speed, say 1,200 revolutions per minute. In places where compressed air is not available an electric motor would no doubt prove equally well adapted for driving the brush.



Rotary Brush Used for Car Cleaning

The brushes used in cleaning the cars are made especially for this purpose in the company's shop. The back is of poplar wood 8 in. in diameter. The holes in which the tufts of bristles are set are ¼ in. in diameter and are spaced about ⅜ in. from center to center. The spacing of the holes is laid out on a sheet metal templet which is placed over the wood back and serves as a guide when the holes are drilled. The bristles are of capitol Tampico and project about an inch and a half from the back. Each tuft is held in place by a wire staple driven in the hole and is further secured by setting in glue. The proper shape and size of the brush are important. The flat surface should not be so large that the motor is slowed down when it is pressed on the work and the edge must be designed to reach into the corners. By alternating the direction of drive, at suitable intervals when in use, these brushes can be used on a large number of cars before they are worn out. The cost of making them is less than one dollar each.

The flexible shaft is attached to the back of the brush by a small plate held on with screws, the nut which holds the plate to the driving shaft being set in the recess in the brush. In order to reduce the torsional force on the handle, a ball thrust bearing is placed between the handle and the plate. The handle is a piece of steel tubing which is soldered to the casing of the flexible shaft. The other end of the casing is screwed onto the air motor gear case. As the shaft is bent, its length changes slightly, so it is necessary to provide end play in the connection between the shaft and the motor. This is accomplished by drilling a straight hole in the motor spindle and setting a segment in with screws. The tail piece of the flexible shaft which extends into the spindle is made flat on one side so that it will fit the shape of the opening in the motor spindle.

In using the power driven brush, the cleaning compound is applied to the car precisely as when doing the work by hand. It has been found, however, that a smaller amount of the cleaning mixture is required when it is used with the power brush.

In cleaning along the top of the car the operator stands on a scaffold, while the space under the windows can easily be reached from the ground.

The comparative cost of a thorough cleaning of cars before and since the introduction of the power driven brush are as follows:

Cleaning by hand—		
Labor	$8.58	
Material	4.35	
Total		$12.93
Cleaning by power—		
Labor	$3.90	
Material	2.73	
Total		6.63
Net saving		$6.30

The first cost of the apparatus is small and the incidental expenses for brushes and power are negligible as compared with the saving effected.

EFFICIENCY IN THE CAR DEPARTMENT

BY W. K. WILMOTT

Efficiency in the car department depends upon the personnel of the department, the organization, the use of modern tools and machinery, and the making of car betterments.

The master car builder or supervisor should be a man with practical experience in car matters with jurisdiction and general supervision over all car shops and car department men. As head officer he will pass final judgment upon all questions relating to car inspection, car repairs, car shop equipment, car repair department billing, and other car department matters.

From among men with special qualifications, the supervisor of the car department may appoint a number of travelers, who will visit all repair points on the line and instruct others in the best practices and improve their efficiency. Among these appointees may be a traveling car foreman, traveling car inspector, traveling car clerk, traveling bill clerk, etc. These men should personally investigate all matters assigned to them by the head car department officer, as well as give general instructions to those on the line pertaining to car matters. For instance, the traveling car foreman may inspect all car shops from time to time, and instruct local car foremen wherever his experience dictates. Stations that render repair cards improperly should be instructed by the traveling bill clerk. Car repairs, in fact, are so voluminous today, that more expert supervision is required, especially at the outside repair points, and this is accomplished by increasing the personnel of the car department supervising organization, as mentioned above.

Organization is a great thing. With the personnel of a department up to a high standard, the head of the car department may appoint a gang foreman over every ten or twenty men, with the view of promoting this man to a higher position when an occasion arises. The probability of promotions, in the car department, is an incentive for men to work for something better. Without encouragement, hope of promotion, and the probability of more wages, it is difficult to retain workmen of much worth in the car department. A common condition or complaint is that some of the needed men have quit, and this is sometimes due to improper organization.

The need of modern tools and machinery have been overlooked on some railroads, but with the cost of labor as high

as it is at the present time it pays to use good tools. Drop pits, overhead cranes, electrically driven saws and hand tools, planing machines, etc., are necessary in handling general car repairs. Machinery soon pays for itself where there is plenty of work to do, and there should be no fear of car departments running short of work with the large amount of business being handled. But the heavy work should be concentrated at the nearest large shop or division shop. The smaller stations should make only ordinary running repairs, while the main shops should do the heavy work.

Wrong repairs or improper repairs is a feature to which most railroads are giving more attention than formerly. The company that makes wrong repairs does its work for nothing, for even though the repairs made are billed, the foreign owner seeks defect card protection in correcting the wrong repairs when the car returns home. Car inspectors are closely inspecting their road's equipment when cars return home, obtaining joint evidence statements for wrong repairs and demanding defect cards from the roads that did the work improperly. Car men of mature judgment avoid making wrong repairs to foreign equipment and are alert in obtaining joint evidence for wrong repairs on the cars belonging to their own road.

Car department apprentices are none too many. There are many young men who might make a success as car repairers. The principal requirement is that they be able-bodied and of some education. These young men, however, cannot well displace the older car men, for the reason that mature judgment in car matters comes only from *experience,* with the result that the longer the experience of a car man the more he knows.

Metal work, of late years, has become a matter of car repairs, with car departments having little equipment for handling it. Main shops should be equipped with riveting machines, and other machines for straightening metal car sides or ends, steel underframes, etc. Much work of this kind is now being handled by the locomotive department smithshop by workmen inexperienced in car matters. Inasmuch as car repairs now includes metal work, as well as wood work, it is necessary to provide the car department with additional equipment to handle this class of work.

A very improper thing among experts, especially traveling car department men, is the limited authority with which they are clothed, it being required in some cases that they locate bad conditions and report them, while as a matter of efficiency they ought to be authorized to correct adverse conditions while on the ground. Of course, this requires the employment of experts who are well drilled. To read a long report of adverse conditions, then have to go all over the ground with a view of making the required betterments, is a slow way of getting action in these modern days. The man who can go out on the line and put everything aright while he is there is the man the supervisor of the car department should add to his personnel, whether he be traveling foreman, inspector, car clerk or bill clerk. Of course, these men may occasionally find conditions which are necessary to report, rather than to correct, but the general tendency ought to be for the traveler to report that which he has corrected, instead of reporting to the head officer what he found.

Car repair billing is today a big item. It requires much supervision to have it done correctly, but by placing it under one head it can be handled authoritatively. The car department may mark the repair cards, showing the car repair charges for each individual car. It matters little who makes the bill or adds or verifies the charges. When outside stations send in repair cards that are improperly rendered, the car department should hand them to the traveling bill clerk who will instruct the car shop clerks regarding the rendering of repair cards.

Next to freight and passenger revenue comes car department billing. Nothing is thought of paying high wages to passenger and freight department men, but if the repairs of a car do not check with the labor cost, there is sometimes much ado, notwithstanding that even good car repairers are scarce at this rate.

Improve the efficiency of the car department by appointing an efficient staff, devise new ways of organization such as may be needed, and put experts over those holding regular positions, with the view of increasing the efficiency of the car department to its limit.

The First Standard 55-Ton Hopper Car to be Completed for the United States Railroad Administration Just Delivered by the American Car & Foundry Company; These Cars Will be Lettered with the Name of the Railroad to Which They Are Assigned

SHOP PRACTICE

MAIN AND SIDE RODS

BY F. G. LISTER
Mechanical Engineer, El Paso & Southwestern

The El Paso & Southwestern has put into use a number of changes in locomotive main and side rods, which have met with good results.

On power originally equipped with strap back end main

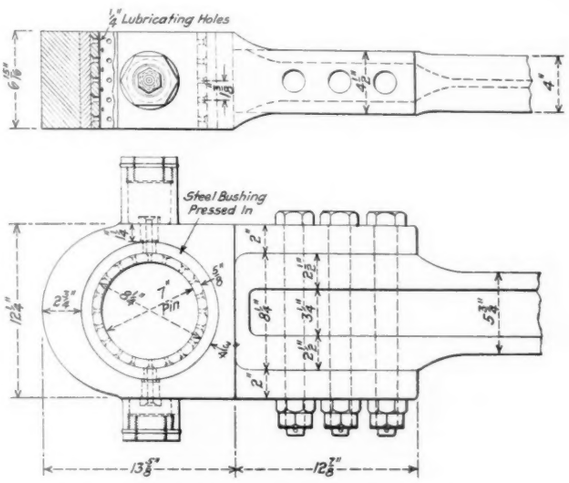


Fig. 1—Detail of Solid Butt End Arrangement

rods, the strap has been replaced by a solid strap end bored out and fitted with a steel bushing pressed in, as shown in Fig. 1. The steel bushing contains a floating bronze liner, or bushing, which is free to revolve, and is a running fit

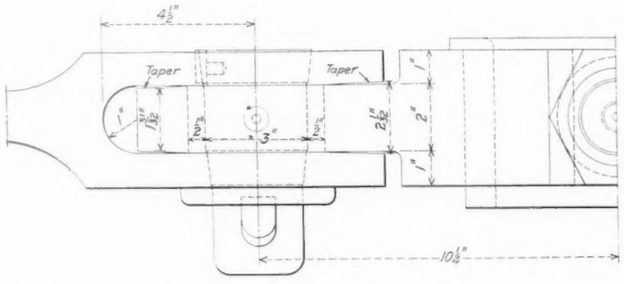


Fig. 2—Lateral Side Rod Strain Relieved by Tapering Tongue and Groove

on the crank pin. This bushing contains a number of ¼-in. holes for the free distribution of grease.

After a satisfactory trial it was decided to apply the idea to some heavy Mikado type locomotives built by the American Locomotive Company in 1916, and to ten Pacific type passenger locomotives built by the same company in the early part of 1917. The main rod back end on these locomotives is an integral part of the rod, no bolts being necessary, and the arrangement of steel bushing and bronze liner being the same as in Fig. 1.

The sectional brasses ordinarily applied to main rod back ends are very heavy, and with the high cost of brass, together with the cost of machining and fitting the brasses, liners and keys, the job becomes very expensive.

The bushing can be turned, bored, and fitted in about one-fourth the time required to fit up the sectional brasses. The amount of brass is materially less, and the floating or revolving action of the liner, or bushing, prevents excessive wear. These bushings average about 40,000 miles for passenger engines and 44,000 miles for freight. The idea was derived from a similar design of main rod in use on the Chesapeake & Ohio, and illustrated in the Railway Age Gazette, Mechanical Edition, of April, 1915.

Experiments have also been made on the main rod front end stub. When necessary to renew a main rod, instead of

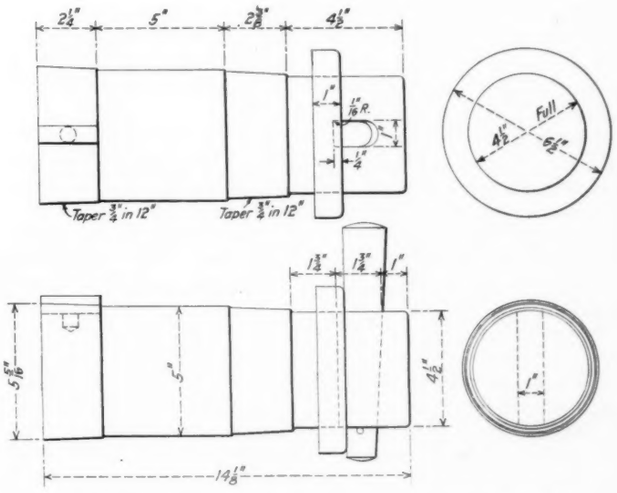


Fig. 3—Arrangement of Wrist Pin Washer and Taper Key

milling out the front stub for the sectional brasses, liner and key, it has been bored out ¾ in. larger in diameter than the wrist pin and fitted with a bronze bushing ⅜ in. to ½ in. thick.

Unnecessary adjustments by roundhouse men, engine inspectors, and engineers is thus eliminated, and galling of the rod in the cross-head is prevented. If excessive wear develops, it is an inexpensive operation to remove the bushing and replace it with a new one.

The lateral strain in side rod connections has been relieved by tapering the rod jaw and tongue, as shown in Fig. 2.

Knuckle pin and wrist pin washers and double nuts have been replaced by washers and taper keys similar to the one

illustrated in Fig. 3. This arrangement has given no trouble whatever, and is believed to possess important advantages over the older method because of decreased cost and greater ease of maintenance.

THE SHORTAGE OF TIN

George Armsby, chief of the Tin Section of the War Industries Board, on May 29 issued a circular to users of babbitt and other bearing metals, solder and tin alloy products, calling attention to the necessity of husbanding the resources of tin on account of the limited supply available. This may be done by eliminating waste, substituting other metals wherever practicable, reducing the percentage of tin used in various alloys and by recovering larger quantities. The War Industries Board has conferred recently with representative manufacturers of babbitt and other bearing metals, solder and miscellaneous tin alloy products for the purpose of explaining the present situation and in order to obtain suggestions as to the most practicable methods for conserving tin. In co-operation with the Bureau of Standards a number of experiments have been conducted, and circular reports of the findings resulting from the experiments and from inquiries made among a number of large manufacturers and consumers have been sent out. All users of the materials referred to are asked to give their full co-operation. The suggestions of the Bureau of Standards for the conservation of tin include several formulae for babbitt mixture for various purposes in which other metals are substituted in order to reduce the tin content and it has shown that while certain types of bearings require a very high grade of lining, others in which the requirements are less severe may contain smaller proportions of tin and a greater percentage of lead or zinc. It is stated that one large manufacturer of machine tools does not use lined bearings at all, believing that bronze alone is sufficient. The part of the circular referring to babbitt and other bearing metals is as follows:

Many specifications for bearing metals now in existence call for virgin tin (Banca or Straits). A large saving of these high grades of tin could be brought about by allowing the use of second quality pig tin in making tin-base babbitt. Detrimental impurities could still be limited, but lead could be allowed to a maximum of one per cent. This would not be harmful in any way to a tin-base or lead-base lining metal.

There is no question that the tin content can be reduced somewhat in all bearing alloys. In a few cases, such as for airplanes, crank-shaft bearings, etc., it may not be feasible to reduce the tin content by any but a small percentage, whereas in other cases it can be cut down very considerably. In the present emergency every possible saving, however small, should be effected.

For those cases where genuine babbitt is now used and which require a very high grade of lining, alloys such as those given in columns 1 to 4 inclusive, of Table I, are suggested.

Table I—Per Cent Composition of Bearing Metals

	1	2	3	4	5	6
Tin	85	84	65	62	8	5
Antimony	10	8	..	..	8	7
Copper	5	8	3 to 6	4	4	2
Lead	..	..	..	..	80	10
Zinc	..	..	28 to 30	33	..	76
Aluminum	..	..	..	1	..	..

One large bearing metal manufacturing concern states that the tin should be reduced in favor of lead. Lead-base linings can be used in many cases where tin-base linings are now used, and in general are just as satisfactory. Many manufacturers already use the lead-base metals, but their use could be made more universal. Several special types of lead-base linings, hardened with alkali or alkali earth, are reported to be giving very satisfactory service in the place of high tin babbitt.

One firm states that it is using the substitute compositions given in columns 5 and 6, Table I, instead of those given in columns 2 and 3, in order to conserve tin. These have apparently been found to do the service required of the tin-base linings in machine tool work.

Another large manufacturer of machine tools does not use lined bearings at all, believing that bronze alone is sufficient. There is probably no question, however, that the lined bearing is cheaper because of the less amount of machining necessary in making the bearing. It is also claimed that the cost of replacement of a lined bearing is less than that of a bronze bearing and has to be made less frequently. One way in which lining metal can be saved is to use just as thin a lining as it is possible to have in order to maintain a high enough temperature during pouring to insure a firm bond and solid mass of metal.

In place of a bronze used for bearings containing 80 per cent copper, 10 per cent tin and 10 per cent lead, the alloys given in Table II might be substituted as having been thoroughly tried and found satisfactory.

Table II—Per Cent Composition of Bronze Bearings

	7	8	9	10	11	12
Copper	81	79	74	64	Remainder	Remainder
Tin	7	5	5	5	8	5
Lead	9	15	20	25	15	17½
Zinc	3	..	..	..	1½ to 3	5
Antimony	..	..	..	5	..	..
Phosphor copper	..	1	1	1	..	..

With the co-operation of all, in consideration of the above suggestions, it seems probable that much less tin could be used in bearing metals without in any way impairing their service. It is believed that a saving of at least 25 per cent could be brought about by a judicious selection of the proper composition of either bronze or lining to use for each particular service and by insisting upon its use.

DEFINITIONS OF TERMS USED IN AIR COMPRESSOR RATING

Upon the recommendation of its Technical Committee the Compressed Air Society has adopted the following definitions of certain compressed air terms in order to eliminate confusion as to their exact meaning.

Displacement.—The displacement of an air compressor is the volume displacement of the net area of the piston.

Capacity.—The capacity should be expressed in cubic feet per minute and is the actual amount of air compressed and delivered, expressed in free air at intake temperature and at the pressure of dry air at the suction.

Volumetric Efficiency.—Volumetric efficiency is the ratio of the capacity to the displacement of the compressor, all as defined above.

Compression Efficiency.—Compression efficiency is the ratio of the work required to compress isothermally all the air delivered by an air compressor to the work actually done within the compressor cylinder as shown by indicator cards, and may be expressed as the product of the volumetric efficiency, the intake pressure and the hyperbolic logarithm of the ratio of compression, divided by the indicated mean effective pressure within the air cylinder or cylinders.

Mechanical Efficiency.—Mechanical efficiency is the ratio of the air indicated horsepower to the steam indicated horsepower in the case of a steam driven, and to the brake horsepower in the case of a power driven machine.

Overall Efficiency.—Overall efficiency is the product of the compression efficiency and the mechanical efficiency.

The society, which is composed of air compressor manufacturers, recommends that the use of other expressions of efficiency be discontinued.

BOLT MANUFACTURE IN RAILWAY SHOPS

A Consideration of Methods and Tools Necessary for the Rapid Production of Bolts in Railway Shops

BY M. H. WILLIAMS

RAILWAYS are large users of bolts and rivets, of practically all sizes and shapes, and this endless variety has made it necessary to go into their manufacture more with the object of meeting demands for odd sizes than to effect a saving as compared with their purchase.

The required bolts and rivets can be made on the following machines: Hammer heading machines, bolt heading or forging machines, automatic feed bolt machines, and cold heading machines. The threading of bolts can be done on the regular bolt threaders or on thread rolling machines. In

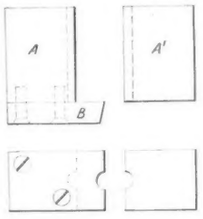


Fig. 1—Cutting-off Arrangement

some shops a number of bolts are finished on lathes, bolt skimming machines and automatic screw machines. The latter, covering the turning of finished or taper bolts, will not be considered.

Bolt heading machines are generally well known in the railway shop, therefore only a brief description will be given of each type. More attention will be given to the subject of tools and rate of production, to enable those who have not had an opportunity to look carefully into the various classes of machines to form an opinion of their relative value for their particular requirements.

Hammer Headers—One of the older designs of bolt heading machine on which the finest quality of bolts may be made is the hammer header. It has the customary horizontal moving ram, operated from the crank shaft, which carries the die for forming the top of the bolt head. Two vertical and two horizontal moving rams are operated by toggles to form the sides of the bolt head. The gripping dies for holding the body of the bolt, also are operated by toggle action.

When manufacturing bolts on this type of machine it was customary to cut the blanks to the proper length previous to heading. However, some of the later machines are arranged to cut the blank when heading, the latter operation being confined to relatively short lengths. The sequence of operation is as follows: The operator places the heated blank between the two gripping dies with the rear end against a stop. The lever is pulled that causes the gripping dies to close on the blank. A second lever is pulled that sets the various heading rams in operation. The main horizontal ram moves forward and the heading die upsets the end of the blank. Next, the horizontal ram dies strike the sides of the bolt head, and a moment later the vertical dies strike the bolt head. This operation is repeated as many times as is considered necessary in order to produce a satisfactory head, the first one or two blows working the metal only into a rough resemblance of a bolt head, the repeated blows forming the finished head. After the head is formed the starting levers are released and the finished bolt is removed by the operator.

To reduce labor and increase output, a later type of machine has been designed known as the semi-automatic hammer header. This machine is similar to the one referred to above, with the addition of a cam motion that automatically closes the gripping dies, moves the stop for the rods back of the gripping dies at the right moment, and governs the number of strokes of the various heading tools. With this design of machine it is only necessary for the operator to place the blanks in the machine, the cams attending to closing the gripping dies and all other operations. When the head is completed, the bolt falls into a receptacle below the machine. The operator is not required to remove the finished bolt from the machine or operate levers and can devote his entire time to feeding the blanks. The cams and the speed of the main shaft govern the theoretical output and with a good operator and heater, the output will be from 6,000 to 10,000 bolts per day.

Some of these later semi-automatic hammer headers are also arranged to cut the heated stock to the correct length, this being done by a shear blade attached to one of the gripping dies. This arrangement is shown in Fig. 1, A A^1 being the gripping dies, B the shear and C a stop to govern the length of rod that may be fed. The dies are shown in the open position. As the gripping dies close, the heated stock is cut off between the shear blade B and the die A^1. The stock is then carried along and firmly held in the gripping dies. The stop C is controlled by cam motion, being in front of the opening in the dies when the latter are open and out of the way when closed.

When operating this class of machine with the shearing device, it is customary to heat from two to four feet of bolt stock and feed it to the machine. As each bolt is made, the

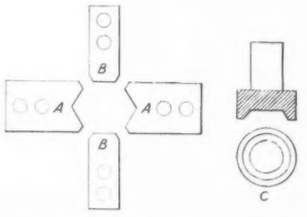


Fig. 2—Heading Dies Used with Hammer Header

stock is advanced, this being continued until the heated portion is made up. Separate lengths of gripping dies A A^1 are necessary for each size and length of bolt required.

On any of the hammer heading machines mentioned above excellent bolts may be manufactured and if the blank is given a sufficient number of blows, the corners will be sharp and the heads well formed. Fig. 2 illustrates the form of heading dies employed on the majority of hammer headers, A A being the horizontal heading dies, B B the vertical dies and C the die for forming the top of the head, which is held in the horizontally moving main ram. The dies A and B are for hexagon head bolts. For square head bolts the dies A A have ends similar to dies B B. One set of these dies can often be employed to form two or more sizes of heads.

The header die *C* can only be used for one size head when bolt heads to correct dimensions are required. These dies are cheap to make and will last a long time. Their manufacture will be taken up later.

Forging Machines or Bolt Headers—This form of machine is used very extensively in railway shops and bolt making concerns for the manufacture of bolts, rivets and a large number of other forgings. For the general miscellaneous work required, it is a question if any machine is better adapted for the purpose. For making bolts and rivets in large quantities, some of the faster machines which will be described later, can often be used to good advantage to take care of the large orders, making use of the above machine for the smaller lots.

The bolt forging machine has the customary horizontal moving ram or header in which the heading dies are held. This is operated by crank motion from the main shaft of the machine. A side ram or slide is also operated by toggles or wedge motion, on which one of the gripping dies is held; the opposite gripping die is stationary. A stop is located back of the gripping dies for the purpose of gaging the length of rod that may be fed. This stop is controlled by cam motion so that as soon as the gripping dies close, the stop raises out of the way before the main header die reaches the bolt blank. A face plate is located in front of the gripping dies and arranged to hold bushings slightly larger than the stock used for making the bolts. This also acts as one blade of the shear for cutting off the stock. A second hole is located in this face plate for the kicker pin that ejects the bolt or rivet when completed.

For making articles that can be headed by one blow it is customary to heat from two to four feet of stock. The heated stock is then passed through the bushing hole in the face plate and onward against the stop. The movable gripping die then advances and cuts off the stock between the die and bushing. The blank is carried along by the movable die and later gripped between the two dies. The header ram and die then advances and forms the head of the bolt or rivet. As the gripping dies open, the kicker pin ejects the finished article which falls through the side of the machine into a pan. After one piece is completed the stock is advanced and the operation repeated until the heated portion is used up. Another rod is then treated in the same manner. By this method a large output may be obtained of bolts or rivets coming within the range of single blow heading. The machines are generally belted to strike from 60 to 90 blows per minute and make a piece at each stroke. The output per day is largely governed by the ability of the operator to feed the stock and take advantage of as many strokes as possible. As the blank is cut off in the gripping dies, it is necessary to provide a separate set for each length and diameter of bolt or rivet manufactured.

This method is limited to simple articles having small heads, such as rivets, track bolts and a few small headed bolts. The amount of stock that may be gathered in one blow generally cannot exceed in length over 2½ diameters. For hexagon or square headed bolts, it is customary to use gripping dies having two or more impressions or passes, the first being largely for gathering the metal, and the second to form the finished bolt. The header ram also has a similar number of dies.

In operation the bolt stock is cut to the required length. Each piece is heated at one end and placed between the two gripping dies. For large bolts a back stop is used to prevent the blank from moving backward when hit by the header die. The treadle is pressed which sets the machine in operation and it goes through the regular operations of one or more strokes as may be desired. After this cycle is completed, the partly formed bolt is placed in the second impression and the cycle of operation gone through a second time, and so on. By this method a very good grade of bolt head may be formed. With proper dies, the bolt heads will show up fairly sharp at the corners but as a general rule are not as well formed or as smooth as those made on hammer headers.

Automatic Continuous Feed Machines—The single blow header with the addition of feed rolls for feeding the stock to the machine eliminates hand feeding and very greatly increases the output. The feed rolls are located in front of the machine in line with the openings in the gripping dies and are rotated with a step-by-step motion by a cam placed on the main shaft. With the automatic machine it is customary to install a special furnace long enough to heat bars of full mill length, generally about 20 ft., directly back of the feed rolls. The furnace is fed from the back, or end away from the machine.

In operation one man is stationed at the back end who feeds the full length of bars to the furnace, the number in the furnace at one time being governed by the time required to heat and the speed of manufacture. This may vary from three bars for small and short work, to eight bars or more for large and long work. As one bar is used up, the furnace man pushes a heated bar forward so that the machine operator can take hold of it with his tongs and enter it into the feed rolls, the end of a new bar being butted against the partly made up bar, so that the operations of heading are practically continuous. As the feed rolls revolve the rod is fed through a quill into the hole in the face plate and onward against the stop gage. The stock is then cut off, headed and ejected the same as on the single blow machine. All the operations of the machine are entirely automatic and require but little work on the part of the operator. The amount of scrap is small, amounting to only a small piece at the end of each bar.

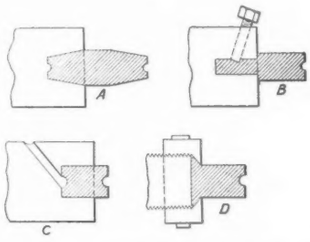


Fig. 3—Methods of Holding Dies

These machines will produce rivets, track bolts and the simpler forms of bolts at speeds varying from 70 to 100 per minute and when provided with good dies can be kept in operation a large percentage of the time. The metal is heated gradually without the danger of overheating common to heating each blank separately. In actual operation it is not uncommon for this class of machine to operate for several hours at a time, making a bolt or rivet at each stroke or at the rate of 4,000 to 5,000 rivets per hour.

Owing to the great speed with which articles are made in this class of machine, the gripping and header dies and the bushings used in the face plate heat considerably, even with a liberal stream of water directed on them. Unless a very high grade of steel is used for these parts they soon wear or develop hair cracks at the edges, making it necessary to stop the machine frequently to renew dies.

Dies, Tools, Etc., for Hot Heading Machines—The accuracy, finish and grade of steel that best meets the requirements for bolt machines in railway shops is somewhat of a question and must to a large extent be governed by the quantity of any particular size to be made. For bolts or rivets made in large numbers, the best grade of steel and workmanship on the dies will generally prove the more economical in the long run, considering the fact that bolt head-

ing machines are expensive and take up valuable shop room. It would, therefore, appear to be poor economy to delay output for want of dies of the proper grade and finish. The manufacture of bolts or rivets having round bodies without fins makes it necessary to finish the grooves in gripping dies very accurately. Lost motion in the side ram is also often responsible for the product not being up to high standard of shape and finish.

For dies used in the manufacture of bolts or rivets in large quantities the low carbon high speed steel made especially for hot work will generally be found the more economical in the end. The virtue of high speed steel lies in the fact that it retains its wearing qualities at high temperatures such as bolt dies are subjected to. Where this steel

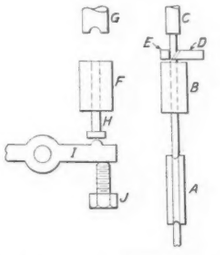


Fig. 4—Cold Heading Machine Arrangement

is used, it should be hardened by the usual method, that is, cooled from about 2,100 deg. F. in an air blast or oil and afterward drawn back to from 600 to 800 deg. The draw back is very essential to prevent breakage and will not affect the wearing qualities of the steel. It will appear soft, however, when tested with a file. The regular high speed steel, such as is used for cutting tools, is too high in carbon for bolt header dies and is liable to crack as a result of the heating. For dies used only occasionally, the cheaper grades of steels or even worn out car axles can be used to good advantage.

Finishing Gripping Dies—The method of machining gripping dies must of necessity vary with the tool room equipment. The ideal method in many respects is to order the steel in blocks about 4 ft. long and of a section such as may be required. These blocks may be planed, milled or ground to the required size and afterwards sawed to the necessary lengths. By using a power hack saw or band saw, the amount of metal wasted in cutting will not be excessive. Two methods can be used for forming the grooves, one being to clamp two die blanks together and drill between the two, and the second, which in many respects is preferable, being to mill the grooves with a convex cutter of the correct radius, a depth gage being used to insure the proper depth. By milling, the grooves can be made equal in each half of the die, which is somewhat difficult by the drilling method. The surface grinder will be found very useful and economical for finishing new gripping dies and also for repairs to worn dies. For new dies they may be roughed out by either of the methods mentioned above. After hardening, or even with soft dies, the flat surfaces can be finished much quicker than by filing. The half round grooves can be finished very quickly and accurately by grinding, employing a grinding wheel that has been formed to the proper radius on its periphery. By setting up two die blocks at one time on a magnetic chuck or by other clamping methods, the grooves in a pair of dies can generally be ground in less than a half hour, including the average amount of grinding necessary to remove hardening roughness, or wear from service on repaired dies. This also includes the time necessary to true the wheel, which should be done previous to the final finishing cut. Where the grooves and surface are finished by grinding, they can be made very accurate and smooth and the practice will be found economical, due to the fact that worn dies may be resharpened without annealing.

On account of the great variety of shapes of gripping dies, no attempt will be made to explain all the forms employed. It is to be regretted that these have not been standardized.

Header Dies for Single Blow Machines—Several methods are employed for holding heading dies in the horizontal moving ram of bolt heading machines and a few common forms are shown in Fig. 3. That shown at *A* is double tapered and usually made with an impression for bolt or rivet head on each end, the holder, or ram block, having a tapered hole to receive the die. This design when new and held securely in a well made ram block works very well. It has the disadvantage, however, of being difficult to remove on account of the taper fit wedging into the ram block and in the event of wear of the taper hole in the die block, the dies will not hold properly. To make this form requires a relatively large amount of tool steel and the number of redressings are limited on account of shortening the taper surfaces.

The die shown at *B* has a straight shank fitting into a hole in the ram block and is secured by a bolt set purposely at an angle in order to force the shoulder of the die firmly against the ram. This die is easy to remove and not difficult to make but requires a large amount of steel and can only be used on one end.

The die shown at *C* is simple in form, being made from round steel, about three times the diameter of the bolts to be manufactured. The ram block is bored about 1/32 in. larger than the die. The die is made from 3½ in. to 4 in. long originally, and can be refaced several times. As it is shortened, due to refacing, liners are placed back of the die to preserve the original length and avoid altering the location of the ram block in the machine. It is held in the ram block by a set screw. A hole drilled on an angle in the ram block makes it possible to remove the die in the event that it binds from heating or scale lodging between the die and the block. This form has the advantage of requiring a small amount of tool steel; it is easy to remove and can be made with double ends so that as one end becomes worn the second end may be used.

The die shown at *D* is held on the ram block by a method

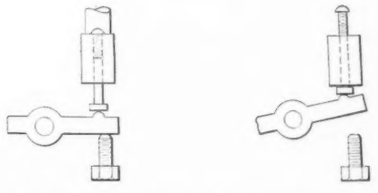


Fig. 5—Forming and Ejecting Operations

similar to that of holding punches in punching presses. It has the advantage of holding very firmly even for complicated or deep heading. It can be removed quickly and in the event of wear or change in length, liners can be placed back of the die. It has the disadvantage of having only a single end and is more expensive to make than the die shown at *C*.

Past practices or the design of the die ram in existing machines often govern the type of dies employed. In many cases a large number of dies have been made and are on hand and a change in the method of holding and the design of the die will involve considerable expense. However, it is always advisable to make all dies, as far as possible, interchangeable for the various machines. This would indicate that some satisfactory design of die and ram block should be adopted and new dies made to the adopted de-

sign and existing dies altered where possible. As a general proposition the die and ram block as shown at *C* will be found satisfactory for bolts and rivets made on single blow headers, and has the advantage of cheapness.

Where bolts or rivets are manufactured in large quantities it will generally be found desirable to make the heading dies from high speed steel as mentioned above for gripping dies. The continuous service will quickly wear the surfaces unless the best grade of steel is employed.

Face Plate Bushings—When making bolts or rivets on the continuous feed machines, or when hand feeding long heated bars, there will be more or less delay on account of wear of the bushings used in the face plate for shearing the stock, unless the very best grade of steel is employed. Here again high speed steel can be used to good advantage. Also, if good work and large output is desired, these bushings should be ground inside and out after hardening to insure a good fit in the face plate and free passage for the stock.

Cold Heading Process—A number of bolt manufacturing companies make bolts and rivets by the cold heading process which eliminates heating and admits of rapid production at a low labor cost. This method is little used in railway shops but has possibilities for the larger roads having demands for small bolts and rivets in large quantities.

For this class of work the material must be a very soft mild steel, cold drawn and accurate in diameter. When heading, the stock is fed automatically into the machine, and each machine will make from 3,000 to 5,000 bolts or rivets per hour, depending on the style and size of machine employed, one operator attending to several machines. Bolts are upset with heads round in form, the contour being that of a section across the corners of a finished bolt. These are afterwards trimmed hexagon or square as required. The trimming is performed in an automatically fed punching machine at the rate of about 3,000 per hour and with practically no labor other than to shovel blanks into the hopper and keep the tools in order.

The cold headed blanks may be threaded on the customary bolt threader or by thread rolling machines, the latter operation being performed at the rate of about 3,000 per hour, depending largely on the ability of the operator to

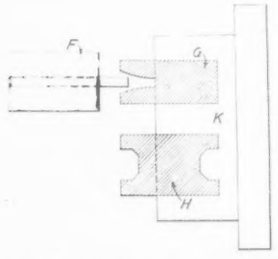


Fig. 6—Double Stroke Heading Dies

feed the machine at the right time. Automatic feeding machines are used mostly on the smaller sizes.

Bolts are generally annealed to remove all strains set up in heading. Rivets intended for driving cold are also annealed. The following description of the process and tools required will assist in forming an opinion of the adaptability of this class of machine for railway work.

Heading Machines—The cold heading machines that have been put on the market by a number of concerns are of very heavy construction and of the highest order of design and finish. On account of their extra strength and weight they cost more than hot heading machines of the same capacity.

The stock from which the bolts or rivets are made is received in bundles similar to telegraph wire, each bundle weighing from 100 lb. to 200 lb. The bundles are placed on stands in front of the machine. The free end is then fed to a pair of feed rolls, the operations being shown in Fig. 4. The two feed rolls, which are held against the stock by spring tension, are shown at *A*. They are slightly grooved to fit the stock to be headed. As each bolt or rivet is headed, the rolls are rotated sufficiently to feed the required amount of stock which passes through a hardened steel cut-off quill *B*, and onward against stop *C*, in front of shear blade *D* and under the spring finger carrier *E*. The shear blade *D* is made concave to conform to the radius of the stock. The shear blade and feed finger carrier are timed to advance together when the stock strikes stop *C*, cutting off the stock, the cut-off blank being held between the shear

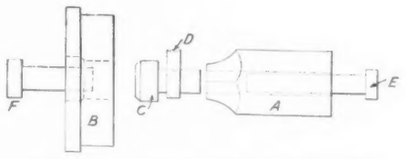


Fig. 7—Dies for Shaping Bolt Heads

blade and the finger. The blank is then carried forward to a position directly in front of the heading die *F*. The heading die *G* which is held in the ram of the machine now advances against the stock and pushes it into the die *F*, the shear blade *D* and finger *E* backing out of the way. The blank continues to advance in die *F* until encountering stop pin *H* which is backed up by stop lever *I* and this in turn by bolt *J*. As the blank is now prevented from going further into the die *F*, a head is formed as shown at the left in Fig. 5. The ram of the machine then backs away and the blank is ejected by the lever *I*, forcing the pin *H* into the die *F*, as shown at the right in Fig. 5. Lever *I* is operated by cams timed with the other operations of the machine. This is what is known as the single stroke solid die header, on which the simpler shapes may be headed by one stroke. Generally speaking, the amount of metal in the head is limited to about 2¾ diameters.

For bolts and rivets having large heads it is customary to use what is known as a double stroke header. With this machine the operation of feeding and cutting off the stock is the same as previously explained. Instead of forming the head with one stroke of the ram, the double stroke machine makes two strokes for each piece produced, the ram being arranged to hold two dies *G* and *H*, as shown in Fig. 6, in a vertically moving slide *K*. These operations are controlled by cam motion as follows: The first die *G* strikes the blank and forms a cone head; the slide *K* then moves backward with the main ram of the machine and at the same time is raised so that die *H* is level with the blank; The main ram then advances and forms the head. The blank is finally ejected the same as in the single stroke header. The various operations of feeding the stock and heading the bolts or rivets all take place automatically and without attention other than to keep the tool in order and new stock in the rolls.

The length of bolt or rivet that can be made on this class of machine is limited by the ability of the ejector pin *H* to eject the blank after the head is formed, the maximum length being about seven diameters.

When necessary to make longer articles it is customary to use what is known as the opening die cold heading machine. This is similar to that explained above as far as feeding the stock and the various operations are concerned. In place of the solid round die *F*, a pair of opening dies similar to the gripping dies used in hot heading machines are used. These are opened and closed by cams forming

part of the machine. On this form of machine the stress on the ejector pin is very much reduced on account of the dies opening partly before the bolt or rivet is thrown out and as a result, articles up to any reasonable length can be made. It is also possible to make a number of odd shaped heads, such as wash bolts that are not practical on the solid die design.

Head Trimming Machines—There are several designs of head trimming machines. One type is arranged with a hopper at the top into which the blanks are shoveled. The blanks are then fed automatically through a chute in front of a horizontal punch. This, as far as handling the blanks is concerned, is an adaptation of the machines used in the manufacture of small wood and machine screws for feeding to the saw or for threading. One form of punch and die used is shown in Fig. 7, in which *A* is the punch made from round tool steel, with a square or hexagon cutting edge. The hole through its center is slightly larger than the bolt body. *B* is the die which is also made from round tool steel. The fitting of the cutting edges of the punch and dies follows the usual practices for punching work. The punch has a gradual taper back from the cutting edge for the purpose of parting or splitting the punchings, which gather up on the punch in rings and gradually drop off as one or more accumulate. An ejector pin *E* is located in the hole in punch *A*, and a second ejector pin *F* in the opening of die *B*. Fig. 7 also shows the end of the feed fingers *D* in position to feed bolt *C* into the punch *A*. In operation the blanks are picked from the hopper chute by fingers *D* and carried to the position shown. The punch then advances partly over the blank when the feed finger *D* lifts out of the way, the blank being now held in the hole in punch *A*. As the punch continues to advance the bolt head is punched to the required shape. The ejector pin *F* in the die then ejects the bolt from the die when the punch has receded. In case the bolt holds in the punch, it is ejected by the pin *E*. The various cams on the machine are timed so that these operations go on automatically in sequence at a rate of about 3,000 per hour.

Thread Rolling—A number of bolts and studs are now threaded by the thread rolling process; that is, the thread is formed by rolling the blank between two dies having grooves cut on their surfaces, corresponding in shape, pitch, and angle to the thread desired. By this method articles can be threaded very much faster than in the customary bolt threading machine. Also, smaller bolt stock can be used.

In order to get a clear understanding of the process of thread rolling, a simple demonstration may be made by taking two pieces of soft pine, free from knots, about 6 in. long and 2 in. square, holding one in a vise. On top of this place at right angles a ½-in. threaded bolt, then press the second piece of pine on the bolt and move the upper piece back and forth. The soft pine will take the impression of the thread and will give a good illustration of the appearance of a pair of thread rolling dies. It will be noticed that the faces of the wood are grooved similar to the thread on the bolt and that the grooves are on an angle similar to the bolt and both slope in the same direction.

There are several designs of machines and dies used, some making use of dies in circular form. For general bolt work the machines having flat dies are the more common and answer the purpose very well. In these machines one of the dies is held stationary and the other is given a reciprocating motion. Most of the machines for small bolts are arranged for feeding the blanks vertically, either by hand or automatically. For the larger bolts and track bolts a machine having vertically moving dies is generally used. The vertical machines will admit of threading long rods where it is often possible to use stock smaller than the thread size, resulting in quite a saving in metal. That is, for 1-in. bolts, studs or long rods can be made from stock about 15/16 in. diameter, which will have practically the same strength as similar articles made from full sized bars and cut with bolt threading machines.

In thread rolling, the pressure exerted by the rolling dies makes impressions on the blank. At the same time the metal between the sharp edges of the die grooves flows upward. The amount of metal raised above the original surface of the blank about equals the depressions. It then follows that the size of stock for the manufacture of rolled threaded articles about equals the thread pitch diameter. For ½-in., 13-thread bolts it is customary to use stock .446 in. in diameter; for ⅜-in., 16-threads, .331-in. stock; ¼-in., 20-threads, .215-in. stock, etc. The dies for thread rolling are manufactured from carbon tool steel 1. to 1.20 per cent carbon.

In manufacturing the flat dies, the blanks are machined to the required size and the grooves milled on the cutting face to suit the bolt to be rolled. When milling these grooves it is customary to clamp the block on the table of a universal milling machine parallel with the center line of the table. The table is then set to an angle equal to the angle of the thread. This taper is given in inches per foot in literature supplied by the manufacturers so that it is not difficult to properly set the machine.

When rolling a thread, the blank to be cut will revolve one complete turn in a distance equal to the circumference of the stock used. That is, for ½-in. bolts the diameter of the stock, .446 in., should be considered and not ½ in. Dividing the circumference in inches into 12 will give the number of turns the blank will make in traveling one foot. It is also evident that the thread will advance one thread per turn. By multiplying the pitch distance by 12 and dividing by the circumference of the blank, the amount the table of milling machine should be set over per foot will be obtained. As the tables of universal milling machines are generally graduated for taper in inches per foot, the setting of the proper taper is not a difficult operation.

Separate dies must be made for each thread and diameter. That is, one set of dies cannot be used for 7/16-in. and ½-in. bolts, even if the number of threads per inch be the same. These dies must be carefully made and also carefully hardened. In practice a set of dies will cut from 200,000 to 500,000 bolts before refacing is necessary. To reface, the dies are annealed and handled the same as new dies.

When setting the dies in the machine it is necessary to adjust them so that the two will track on the thread. This is done by slightly raising or lowering one of the dies and is not a difficult operation. The adjustment for diameter is obtained by adjusting together or apart as may be required. After a set of dies is once properly set, little readjustment is necessary. The output of these machines is limited by the ability of the operator to feed the blanks. A lively boy or girl can readily feed a machine rolling 50 bolts per minute, this being much faster than cutting in a bolt threader and not as fatiguing to the operator.

The cold process of making bolts and rivets has the advantage of cheap production, but requires a very high order of tool room work to properly make and maintain the dies and tools. At least one good machine operator must be employed on a group of machines to keep everything in proper order. The feeding can be looked after by operators having little experience. The tools for making bolts or rivets by the cold heading process must be very exact in regard to size, and highly finished. Referring to Fig. 4, the dies and quills *B*, *F* and *G*, are made of carbon tool steel. The outside after hardening must be ground to a limit of about .001 in. The hole in die *F* must be very carefully lapped or ground and of one diameter for the en-

tire length. Unless this is the case, satisfactory service will not follow. The hole is made .003 to .005 in. larger than the stock to be headed. The heading dies *G* and *H*, Fig. 6, are of similar material. The recess or impression for the head must be correct. It is customary to fit these to a master gage. They must be polished after hardening. When hardening the dies it is necessary to obtain hard surfaces around the hole, which receives most of the wear. This may be obtained when quenching by directing a stream of water through the hole or onto the face of the header dies. All dies should be ground on their ends. The shear blade *D* must be ground on the flat surface after hardening. The dies will often make 100,000 to 300,000 bolts or rivets before requiring regrinding, their life being governed largely by the amount of rust or dirt on the material used. Dies can be made originally for the smaller sizes of belts or rivets and enlarged for the larger sizes as they wear. As a general proposition the cost of maintaining tools for cold heading is less per 1,000 bolts or rivets than for hot heading. The stock for cold heading must be cold drawn and should be lime coated to prevent rust. The price of this stock varies with market conditions, but is generally cheaper than hot drawn for the smaller sizes. The cold heading method eliminates the use of furnaces for heating the blanks required for hot heading. This is offset somewhat by the necessity of annealing the bolts after heading for the purpose of removing all strains that may be set up by the heading process. But a large number of bolts can be annealed at one time and with a smaller consumption of fuel than is required for hot heading.

Bolts made by the cold process will answer practically all purposes except where it is necessary to have a tight fitting bolt. For ash pans, air brake hose, jackets and a number of places they answer all requirements. The principal argument in favor of the cold heading method is low cost, large production per man, the small shop space required and the superior product. With the solid die machines, rivets may be made entirely free from fins or burrs under the head. This is especially desirable for bolts to be used on surfaces to be painted over, such as on steel passenger cars where a rivet having fins under the head is liable to shift and crack the paint.

ANOTHER WAGE INCREASE FOR MECHANICAL DEPARTMENT EMPLOYEES

Director General McAdoo announced on July 24 by telegraph from the west, his approval of Supplement No. 4 to General Order No. 27, providing the following minimum rate and increases in wages for employees of the mechanical department of railroads under federal control:

1. Machinists, boiler makers, blacksmiths, sheet metal workers, moulders and first class electrical workers, 68 cents an hour.
2. Carmen and second class electrical workers, 58 cents an hour.
3. Helpers, 45 cents an hour.
4. Foremen, paid on an hourly basis, 5 cents per hour more than their respective crafts.
5. Foremen, paid on a monthly basis, an increase of $40 a month, with a minimum of $155 and a maximum of $250.
6. The new rates are retroactive from January 1, 1918.
7. Beginning on August 1, the eight-hour day will be applied, with time and one-half for overtime, Sundays and seven specified holidays.

The new order is lengthy and in detail, and at the time this is written the full text has not yet been issued.

In revising the report of the Railway Wage Commission Mr. McAdoo increased the recommendation for shop employees to a minimum of 55 cents an hour, after which, at hearings before the Board of Wages and Working Conditions, the shop organizations asked for 75 cents an hour. To meet the increase asked would involve an addition of $200,000,000 a year to the payrolls on top of the $300,000,000 increase provided for by General Order No. 27, and other classes of employees have also asked for further advances. To assist him in reaching a conclusion the Director General discussed the matter at a conference with C. R. Gray, director of the division of operation; W. S. Carter, director of the division of labor, and Frank McManamy, assistant director of the division of operation.

PREVENTION OF WASTE VS. RECLAMATION OF SCRAP

BY HENRY J. MILLER

I know a man who is a chicken fancier; not the kind of a fancier who goes in for a farm and a large number of chickens, but rather the kind of a man who thinks he has discovered the solution to perpetual income by keeping a flock of ten chickens, maintaining them on the daily refuse from the table. This man claims the first or initial cost to build a chicken house and purchase the ten chickens is the only cost, and the value of eggs received will soon repay this investment, after which the eggs are a clear gain.

Another man I know of, who has the same number of people in his family, became impressed with the chicken fancier's argument and decided that he, too, would reclaim the waste which was daily thrown away from his table. However, on talking with his wife he was very quickly disillusioned. In the first place, his wife showed him that the actual amount of table refuse she threw away would not sustain even two chickens. Not exactly satisfied with the results of his investigation in his own home, he visited the home of his friend the chicken fancier, where he soon found out the reason why they had so much table refuse for chickens. It was due to poor management in the kitchen. The chicken fancier was under the impression that he was reclaiming waste from his table, while in reality, good management and economical buying would have eliminated the waste. He was not reclaiming—he was buying high grade food products for chicken feed.

The same principle may be applied to the railroads. Wherever one sees a big scrap bin or a big scrap reclaiming plant, the question arises, Is it not possible to eliminate much of this expense by better management?

The writer does not wish to be understood as condemning reclamation altogether. It is possible, however, to lose sight of the real value of reclamation with the result that instead of a saving, reclamation is merely adding to the cost of the scrap pile, in excess of its real return. The reclamation of scrap is to prevent the waste of usable material. This can and should be accomplished right at the local shop or on the division. The best posted authorities as to what is scrap and what can be used over again are the local foremen.

The establishment of one large reclamation plant on a railroad and shipping all scrap to this one plant involves a direct waste. It is a waste of man power, a waste of motive power and an excuse for an even greater waste from the shops. This assertion is made with all due respect to the many large reclaiming plants now in operation. There is use for the reclamation plant, but not for as wide a scope of work as we are often led to believe.

Let us look at the scrap problem of a shop of medium size. The bulk of the scrap is old tires, odds and ends of tubes, pieces of iron from the blacksmith shop, defective pipe, rusted jackets, machine tool chips, broken castings and shop sweepings. What is there in this classification that can be reclaimed and used over again? Where is there any need of a reclamation plant to see that this material is properly

sorted for the scrap market? Like the chicken fancier, it is possible that the source of scrap may be overlooked, and then it is possible to find such valuable parts as bolts, nuts, washers, valves, pipe fittings, pieces of brass, tin ware, etc., in our scrap pile.

Scrap piles have been neglected in the past. They have not been given close supervision and many habits have been formed which to-day are found to be costly. Going back still further, however, there was a time when the scrap bin was literally a scrap bin. It was possible to visit many shops and find nothing but scrap in these bins.

The writer has in mind one shop that handled about 10 heavy repaired locomotives and possibly 150 cars a month. The scrap bin was guarded by one man—a man whom everybody put down as a crank, but who was a 100 per cent scrap bin attendant. The scrap bin was located near the center of the plant, easy of access, and was of sufficient size to allow an ample compartment for each of the many classifications of scrap. The attendant had an eagle eye for anything but scrap. Woe to the man who tried to put anything over on him, for he was a fighter and had a nasty tongue. He reserved one compartment where he put everything regarding which there was any doubt, and during his spare moments would sort over the material, in many cases sending pieces that could be repaired at a small expense back to the shop. From this plant probably not one carload of scrap out of every thirty would not have been passed through any reclamation plant as actually worthless. Why the unnecessary expense of loading, hauling, unloading, sorting and loading again before hauling to a buyer? If this has proved possible at one plant, then why not at others?

At another plant the matter of using second-hand shoes and wedges was taken up with the mechanic who handled that work. He was given the exact cost of the different castings and was shown how much was saved by using a second-hand piece if it was in condition to be used again. This mechanic knew the service of shoes and wedges better than the scrap bin attendant and took pride in saving all the money he could. The result was that what shoes and wedges reached the scrap pile were actually scrap beyond reclaiming. Incidentally, this schooling had a decided effect on the amount of stock used at this shop. If it is possible to educate one mechanic as to the value of using second-hand shoes and wedges, why not educate the men who use other materials, and thus do away with handling so much scrap at the reclamation plants?

The function of the reclamation plant is simply to repair where shop facilities are limited or inefficient to handle material in small quantities. It is evident that the amount of scrap iron at local points would not be sufficient to warrant the installation of reclaiming rolls and it is desirable to select some central point for the installation of a rerolling mill to serve the entire road. Under these conditions, however, each local point should sort such material as can be reclaimed, so that on reaching the reclamation plant it need not be resorted.

At a certain reclamation plant a man was observed reclaiming a large pile of rail spikes, straightening them out cold with a hand hammer. Let us follow one rail spike from the time it started to the scrap pile until it is reclaimed and delivered back to the section gang.

A section man, in pulling the spike out of the tie, bends it. Knowing that there is a reclamation plant on the system he puts the bent spike on the scrap pile. The spike is loaded in a car with other scrap and hauled to the reclaiming plant, where it is unloaded, sorted out and placed before the man with the hammer. He straightens it, after which it is taken into store stock, eventually to be loaded and hauled back to the section foreman. If there is no imperfection in the head or point the foreman uses the spike again. Otherwise he looks the spike over, notes the imperfection and either starts it back on another journey to the reclaiming plant or throws it in the tall grass, where the railroad loses its value as scrap. If that section foreman were educated as to the needs of his railroad and the value of using material economically, is it not possible that one of his men would have straightened that spike on a rail, thus saving the cost of handling and moving? Was it necessary to handle that spike three or four times and haul it to and from the reclamation plant just to have it straightened?

At another plant the discovery was made that many apparently good air pump cylinder packing rings were going to the scrap pile. Investigation disclosed that the mechanic who overhauled air pumps would not use a questionable second-hand ring in a newly repaired air pump. He claimed that such a pump would run six months without repairs, but if a second-hand packing ring was used the pump would probably require attention in a month or so. He had concluded that it was better to throw away a second-hand packing ring worth 40 or 50 cents than to use this ring and in a month or so spend from two to three dollars in making repairs to the pump in the roundhouse.

A visit to a large reclamation plant causes one to wonder why so much good material is shipped there. May not the answer be that too much dependence is placed on the reclamation plant? Place a scrap bin in the center of every plant, with a man in charge who knows good material, and the reclamation plant will receive much less good material, and scrap handling costs will be reduced. A means of education will be provided right where every workman can see what the wasteful use of material results in.

Put some of the money otherwise spent in building a big reclamation plant into educating and securing the co-operation of your workmen and you will receive a larger dividend in return.

MAINTENANCE OF CROSS-COMPOUND COMPRESSORS

The subject matter of this paper naturally divides into two parts, viz, one covering the period between shoppings of the compressor and the other while it is in the shop for a general overhauling. Considering the former first:

Location and Installation.—Cross compound compressors should always be located on the left side, forward of staybolts. While the design of the locomotive will to a certain extent determine the exact location, a location entirely below the running board and as near the rear of the boiler barrel as possible is preferable. A large opening and free-passage strainer should be installed in a vertical position and secured to a substantial bracket. It should be located so as to be free from dirt thrown up by the driving wheels and where it will not be subjected to escaping steam. The two suction openings from the compressor should be piped together with two-in. pipes and a similar size pipe then extended to the strainer.

The oil pipe connection to the steam pipe should be between the main steam valve and governor. With a two-compressor installation difficulty is sometimes experienced in lubricating the steam ends of both compressors, due to unequal distribution of oil. To facilitate this the 1½-in. main steam pipe should enter horizontally into the side opening of a 1¼-in. by 1¼-in. by 1½-in. horizontal tee, located adjacent to and above the compressors. From this tee two 1¼-in. branch pipes of equal length should extend to the compressors.

Lubrication.—When starting the compressor the piston rod swabs should be lubricated with valve oil, the throttle

*Abstract of the report of a committee presented at the Air Brake Association.

opened gradually and the compressor run slowly until all condensation is worked out of the steam cylinders, then the drain cocks should be closed. All drain cocks are to be opened, and left so, when compressor is stopped at terminals. While the compressor is yet working slowly, 10 to 15 drops of oil should be fed to the steam cylinders and 8 to 10 drops to each air cylinder. After obtaining about 40 lb. pressure the throttle can be opened.

The air cylinders should be lubricated regularly, four to six drops, how often depending on the service, but never over six hours apart in heavy freight service, and especially just before starting down a mountain grade. With cab air cylinder lubricators, which are superior to the hand oilers, never attempt to adjust to feed continuously, as the slowest possible regular feed will be excessive.

There has been considerable criticism regarding the use of superheater oil in the compressor air cylinders, the general impression being that it is too heavy, tending to more quickly clog the passageways and packing rings. While it is conceded that better results may be obtained with Perfection valve oil, yet where the special 54 air strainer is employed no trouble is experienced from the use of superheater oil, thus indicating that the gumming with it is mainly due to dirt.

Compressor Laundry.—Dirt entering the air cylinders destroys lubrication and increases the wear of packing rings and cylinder walls. The dirt and worn-off metal form the hard gum so frequently met with; hence, the exclusion of dirt will improve the lubrication and reduce the wear and gumming.

A very effective and economical way to remove this deposit is by means of the compressor laundry, which should be used every three months or longer, depending on the service and protection afforded against dirt. Compressor laundry outfits consist in general of an enclosed tank mounted on wheels, for a lye solution, a steam coil inside the tank and suitable pipe connections to join the tank to the suction and discharge openings of compressor. The solution should consist of about one lb. of concentrated lye to one gal. of water, and should be kept hot by steam circulating through the coil while the compressor is being laundered.

The length of time the compressor should thus operate depends on its dirty condition, but usually from two and one-half to three hours gives the best results. After the compressor has been thoroughly cleansed the tank connections should be removed. Clean water (hot water is preferable) should then be worked through the air cylinders for several minutes, discharging into the pit, to insure all of the solution being removed, after which the compressor should run idle until all the water is worked out of the cylinders. The air cylinders should then be well lubricated, the strainers applied and the discharge pipe connected. If soft packing is used the air ends may need to be repacked. A solution of about 10 gal. will be sufficient to cleanse about five compressors.

Insufficient lubrication, especially in the steam end of the compressor, is one of the most common causes for the compressor running slow. On roads where valve oil seems to be at a premium, either by an oil schedule or otherwise, the air compressor is usually the part that is stinted to make an oil record. At the normal cost, of about 55 cents per gal., for oil it will cost 5 cents per 16-hour trip to properly lubricate both ends of the compressor.

Other causes for the compressor running slow are worn packing rings in the high-pressure air cylinder or clogged passages in the air cylinders. No trouble will be experienced with the latter if the compressor laundry is used as herein recommended. The compressor will pound or make irregular strokes from causes such as main steam valve dry, packing rings in low-pressure air cylinders badly worn, piston rod packing blowing, clogged air passages, air valves with improper lift or leaking, and too much oil in the steam cylinders in combination with close throttling by the steam valve or governor.

The compressor will give good service when the low-pressure air piston packing rings are worn until 3-32 in. to 5-32 in. open. The latter should be the limit.

A slow upward stroke of the low-pressure air piston may be caused by a restricted air passage between high and low pressure air cylinders, or top steam cylinder gasket leaking to the top side of high-pressure steam piston, or high-pressure air piston packing rings leaking, though if the latter were at fault the low-pressure air piston would move slowly in both directions. If the high-pressure air piston makes a quick downward movement and the low-pressure air piston a quick, upward movement, the cause may be on account of a lower intermediate valve leaking or held off its seat. If the quick movements of the pistons mentioned are in the opposite direction than stated, the cause may be from an upper intermediate valve leaking. If the high-pressure air piston only makes short strokes, and compressor will not maintain more than 45 to 60 lb., it indicates discharge passages badly clogged, or final discharge valve leakage.

When a compressor gradually keeps reducing in efficiency until it does not maintain standard pressures under relatively favorable conditions, the trouble is usually due to worn and leaking high-pressure air piston rings. Under these conditions the low-pressure air piston will be working against more than its normal pressure. Low speed can also result from steam cylinder gasket leakage, and if leaking between ports of high and low pressure cylinders, or between low-pressure cylinder and exhaust, it can be located by a continuous blow at the exhaust, providing the exhaust pipe is disconnected close to compressor and the latter run slowly. If the compressor has been maintaining standard pressures, and in a relatively short time does not, the trouble is undoubtedly due to some foreign substance lodging under an intermediate or discharge valve, thereby causing serious leakage. Such foreign substance can at times be removed by closing compressor throttle and brake valve cut-out cock, draining all pressure from main reservoirs, after which run the compressor fast for a few minutes. After the main reservoir pressure is restored, open brake valve cut-out cock.

The report was signed by C. N. Remfry, chairman; T. F. Lyons and Frank Schaller.

DISCUSSION

The discussion emphasized several of the points brought out in the paper, and indicated that the most difficult problem in the operation of the 8½ in. cross-compound compressors is properly lubricating the air cylinders. The use of signal oil, which is sometimes permitted, has resulted in explosions in the air cylinder, and is not desirable. The difficulty of using present types of hydrostatic lubricators on these pumps is that the minimum feed is too fast for continuous use and requires periodical attention from the engineman. Another handicap under which these pumps work is the inefficient condition in which air strainers of the ordinary type are maintained, the openings being partially clogged and restricted. More attention to maintaining unrestricted strainer openings was advocated.

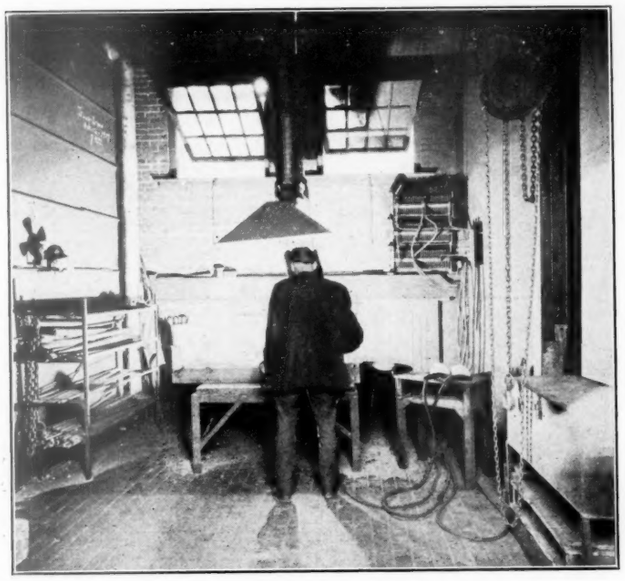
A CORRECTION

In the article entitled Metallic Electrode Arc Welds, by O. S. Eschholz, published last month, an error was made in the second column of page 417 in giving the carbon and manganese content of the electrode. This should be .17 per cent carbon and .5 per cent manganese.

WELDING METHODS AT COLUMBUS SHOPS

Carbon and Metallic Arc Welding Both Used; A Special Building Has Been Erected for Welding Work

THE Southwest System of the Pennsylvania Lines has recently erected at the Columbus, Ohio, shops, a special building which is devoted exclusively to electric welding. Many interesting details were incorporated in the design to fit the structure to the purpose for which it was intended. The building is of brick 101 ft. long and 19 ft. wide and is divided into seven welding rooms, 12 ft. by 16 ft., inside, and a generator room, 14 ft. by 16 ft. The generator room has brick walls, while the welding rooms are separated by corrugated iron partitions. As the light from the arcs is harmful to the eyes unless shaded by colored glasses, provision has been made for protecting anyone from the rays who may come in the vicinity of the building. The windows in the welding rooms are 8 ft. from the ground and the opening near the welding table for the admission of air is covered by an iron door hinged at the top. The entrances to the welding rooms have sliding doors, one solid and the other with latticed panels, to provide ventilation. In order to insure that all fumes from the arcs will be carried away quickly an exhaust fan has been installed in the generator room and connected to a central duct, from which smaller ducts in each room lead to adjustable exhaust hoods directly over the welding table. There is also an 18-in. roof ventilator in each room. The entire building is heated by warm air pipes brought in at the floor level.



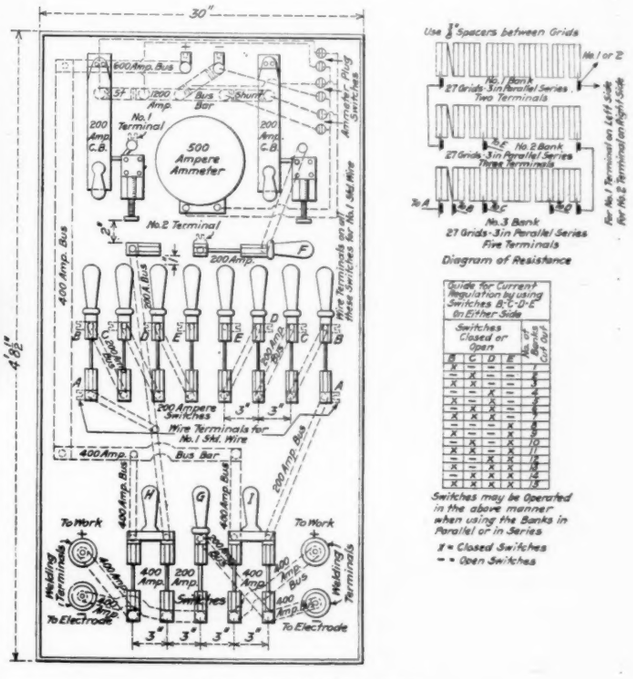
Interior Arrangement of Welding Room.

The arrangement of the apparatus in the welding rooms is clearly shown in the illustration below. A welding table is provided to bring the work to the height most convenient for the operator. Beside the table is a stand on which the electrode holders are placed. A rack for the welding rods and a metal box for holding tools are also provided. To facilitate the handling of heavy parts each room has a chain hoist of 1-ton capacity swung from a jib crane.

The generators used for electric welding were rewound from two 60-hp., 240-volt motors. By running connections to each third commutator bar they were changed to give approximately 80 volts. The fields are compound wound with a differential series coil. The generators are driven by 100-hp. induction motors. Each machine delivers a maximum of 1,000 amperes, which is sufficient to supply one metallic arc and two carbon arcs.

In the generator room is a small switch board which carries the volt meters and ammeters, the field rheostat and the circuit breakers, which are connected with the positive side of the circuit. The welding circuits are carried from the circuit breakers by separate leads to each of the welding rooms and are brought back to the center post of a series of single pole double throw switches, through which any of the circuits may be connected to the negative terminals of either generator. The circuits are designed to carry a current of 600 amperes.

One circuit is carried to the erecting shop, where it is connected to the welding panel shown in the illustration below. This is arranged for the use of two operators on metal electrode work. If it is desired to use a carbon arc the entire current can be diverted to either set of welding terminals by closing the switch *G*.



Two-Man Welding Panel.

The welding practice at Columbus shops is quite unusual in that much of the work is done with the carbon arc. The carbon arc process was the first method of welding metals with the electric arc that was developed, and has been in use since 1881. The welding heat is generated between the work and a carbon electrode, the arc being played around on the work to get the proper heat, while the metal to be added is fed into the arc. In many ways the manipulation of the arc is similar to the manipulation of the oxyacetylene flame.

Metal electrode welding has been adopted much more generally than the older carbon arc process, which is in use by very few railroads. The reasons generally ascribed for the

use of the metal electrode process are that the quality of the metal added is better than is secured when using the carbon arc, that the heat can be controlled more readily, and that it can be used for overhead welding and other work where it is not possible to form a pool of the molten metal.

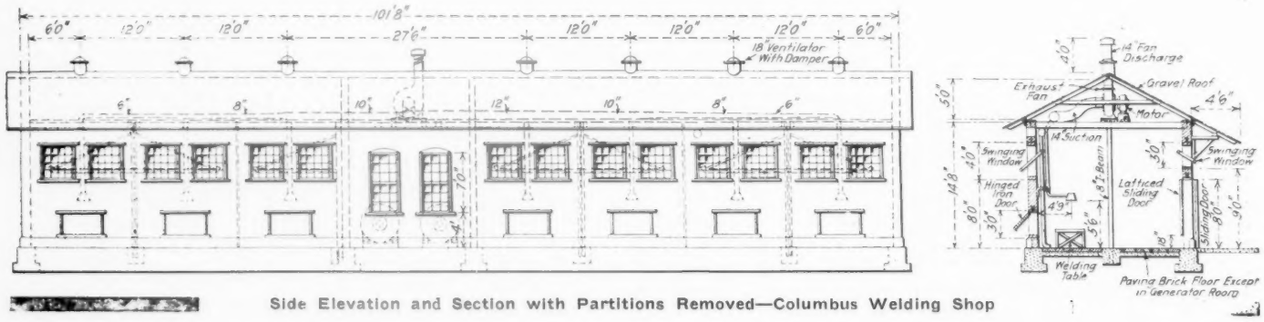
The advantages of the carbon arc process which led to its adoption in the Columbus shops are the greater speed in building up work and the lower cost on heavy work. When using the carbon electrode a longer arc is maintained than when using the metallic arc and for that reason it has been found the slight variations in the length of the arc have less effect on the quality of the metal. The character of the work secured depends largely on the skill of the operator. It has been found that an experienced operator can produce a very good grade of metal in the welds. The intense heat of the arc makes the molten metal so fluid that it is easy to float off the scale.

About three-fourths of the work done at Columbus is welded with the carbon arc. This includes practically all building up operations and repairing the commoner classes of broken parts. All crosshead guides are maintained to a standard size, from ¼ to ¾ in. of metal being added to restore the original dimensions. Chafing castings are built up with the carbon arc, holes in spring rigging and brake rigging that are worn out of round or spots that are chafed are built up. Broken driving and trailer boxes, and in fact practically all kinds of steel castings, are welded with the carbon electrode. Copper can also be welded by this process with entire success. No difficulty is encountered in machining the metal which is added.

In carbon welding, electrodes ½ in. and ¾ in. in diameter are used. The rods, which are fed into the arc, are ⅜ in., ½ in. and ⅝ in. in diameter. The voltage across the arc varies from 50 to 55 volts and the current is usually between 400 and 450 amperes.

In working with the carbon arc the face and hands must be protected, as the rays from the arc will burn the skin. A very convenient and practical form of face shield has been developed at the Columbus shops. It is made largely of fiber which is light and a non-conductor of heat and electricity. The frame which holds the colored glass is hinged and is held in either the open or closed position by a spring. A fireproof bib protects the chest of the operator from the heat of the arc.

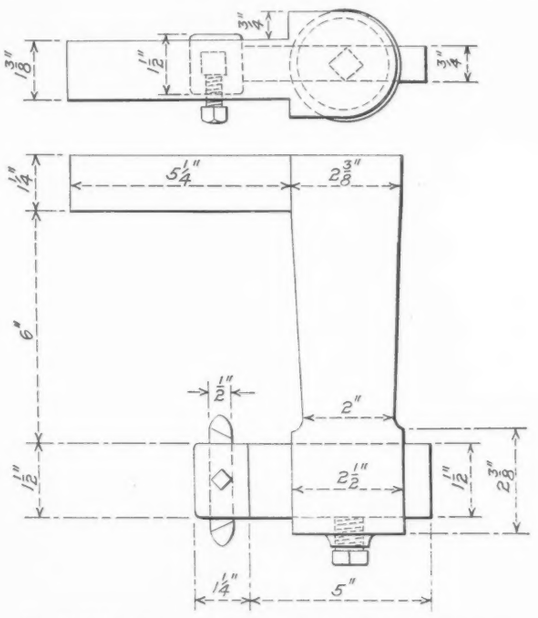
There are certain classes of work for which the carbon arc is not well adapted and for such operations the metallic arc is used. These include the welding of firebox cracks and seams, mud rings and tubes, welding broken locomotive frames and broken spokes in wheel centers. Link blocks, valve stems, superheater units and crossheads are built up with the metallic arc. On these classes of work a voltage of approximately 18 to 20 volts across the arc is used, with a current from 100 to 175 amperes. The electrodes used on building up operations are 3/16-in. or ¼-in. Swedish iron. On firebox work ⅛-in. rods are used, on tubes ⅛-in. annealed iron wire and for overhead work steel wire with a high melting point.



Side Elevation and Section with Partitions Removed—Columbus Welding Shop

A CROSSHEAD FACING TOOL

The inner surfaces on the sides of crossheads are difficult to machine in a slotter. Nevertheless on account of the difficulty of reaching these points with an ordinary lathe tool the surfaces are usually slotted out. The illustration below



Tool Which Cuts the Time for Machining Crossheads

shows a tool used in the Bloomington shops of the Chicago & Alton which makes it possible to finish both of the inside surfaces on crossheads at one setting.

The body of the tool is designed to pass through the crosshead pin hole, with considerable clearance at the sides. On one end the tool has an arm which fits in the tool post of the lathe. The other end carries a removable arm in which there is a double end cutter held in place by a set screw. The body of the tool is passed through the crosshead pin hole, and the removable arm is then placed in position. By using the cross feed the inner surfaces can be finished in perfect alinement with the outer surfaces. If the clearance of the tool in the crosshead pin hole is not great enough to permit the entire surface to be finished in one cut, the tool can be brought back and the removable arm set out to finish the cut. With this tool the time required to machine crossheads can be reduced considerably. Where nuts are used on the ends of piston rods, a tool of this sort will be found useful for finishing the bearing surface for the nut on the crosshead.

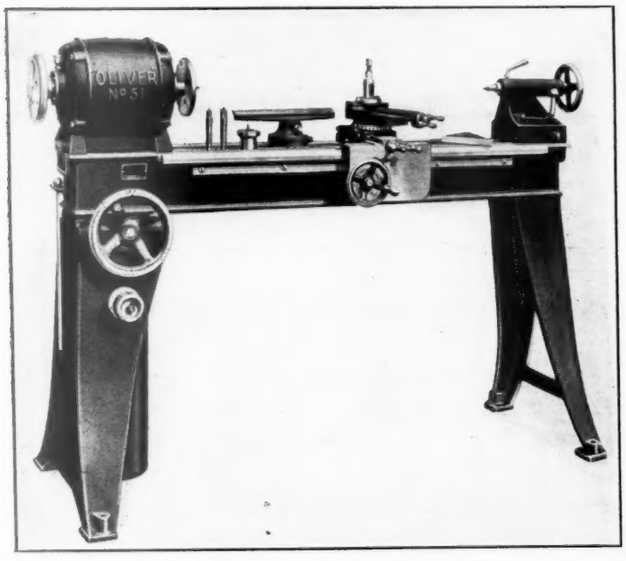
NEW DEVICES

MOTOR HEAD SPEED LATHE

A new speed lathe with alternating current motor headstock has recently been placed on the market by the Oliver Machinery Company, Grand Rapids, Mich. The lathe is designed for three-phase, alternating current operation and is called the Oliver No. 51.

As shown in the illustration, the lathe is provided with a hand feed carriage and compound swivel rests, but may be furnished with a plain bed in four or five-foot lengths if desired. In this case it will turn 24 or 36 in. between centers, respectively. The swing of the lathe is 12 in. and it is well adapted to work in pattern shops.

The motor headstock and ball bearings are totally enclosed, which makes them dust and dirtproof. The rear end of the motor is fitted with a combined handwheel and face



"Oliver" No. 51 Motor Head Speed Lathe

plate, which is a new invention, covering which a patent has been applied for. The outer end is rounded off like the ordinary handwheel and the inside face is curved in so as to give the advantage of the handwheel shape. The outer surface forms an accurate face plate for rear end turning. The motor controller is also enclosed in a dustproof case and is similar in type to a street car controller, but much smaller. It is operated from the handwheel shown in the front, which is marked in the various positions, as follows: Off, 570 r.p.m., 1,140 r.p.m., 1,725 r.p.m. and 3,450 r.p.m. The mechanism is such that the handwheel cannot be turned in the wrong direction. All parts of the lathe are interchangeable.

THREE-WHEEL TRACTOR

The Elwell-Parker Electric Company, Cleveland, Ohio, has developed the tractor shown in Fig. 1 for medium service and to occupy a position about halfway between the common electric truck and the heavy duty tractor. It is giving excellent service in small package freight houses, and Fig. 2 illustrates its use in unloading a freight car of flour.

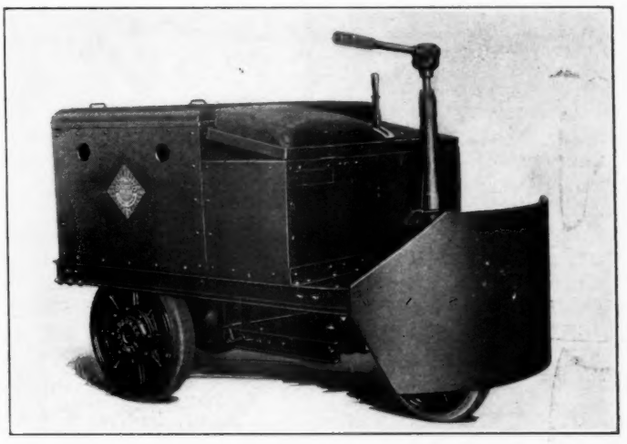


Fig. 1—Elwell-Parker Three Wheel Tractor

There are one hundred 25-lb. sacks of flour on each of the trailers shown, making a total of 10,000 lb. of flour hauled by one motor. One of the distinctive features of the Elwell-Parker tractor is the single front wheel, which makes pos-

Fig. 2—Removing 10,000 Lb. of Flour at One Trip

sible greater ease in turning, and on this account it could probably be used to good advantage in railway repair shops.

The tractor is steered by a handwheel or a hinged right and left hand lever. When the wheel steer is used, the con-

trol lever is located on the left of the column. When the lever steer is used, the control lever is located at the side of the operator's seat, as shown. The steering wheel is carried on roller bearings in a heavy steel box spring supporter, turning on large ball bearings in the steering column base. The seat operates as a circuit breaker, which closes when the operator's weight presses the spring, but only when the controller is in "off" position. The tractor can never be started from the floor.

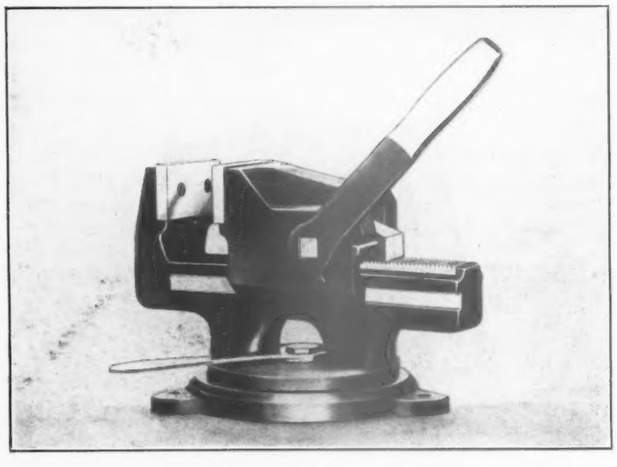
The tractor has solid wheels and solid rubber tires. The normal drawbar pull is 300 lbs., the speed with no load is 625 ft. per minute. The length of the tractor is 70 in. and its width is 41 in. The outside turning radius is less than the length of the tractor. A single reduction worm drive is used, the worm being steel and the worm gear phosphor bronze. The motor is direct connected to the worm on a full floating axle. The tractor has a brake pedal with a heel latch.

The battery may be removed through the top or side of the compartment as a unit, and is not boxed in single cells, as in many tractors. This facilitates the quick exchange of batteries if required. The battery cradle is suspended on springs. The tractor frame is carried on separate sets of springs over the rear axle. There are three speeds in either direction. The tractor is equipped with an Elwell-Parker heavy-duty motor and an Edison or lead battery.

NEW IDEA VISE

The Barnett Foundry & Machine Company, Irvington, N. J., has just brought out a machinist's bench vise under the name of "Winans' New Idea Vise," that embodies a number of novel features. Reference to the illustration indicates its general characteristics. It will be seen that the well known screw and lever has been replaced by a pawl and rack. This is actuated by a handle on an eccentric shaft, which will exert a pressure much greater than possible with a screw.

The adjustments from zero to maximum are made instantly with one sliding movement. The pawl eccentric and sliding jaw form a toggle joint, bringing the greatest pressure to bear on the top part of the jaw, causing the work to be clamped tightest at the working part. The moving member of the vise slides away from the operator and there is no handle between the operator and the vise. The gripping plates are hardened and ground, and the rack and pawl are made of hardened steel.



Winans' New Idea Vise

A feature of especial importance is that the whole vise may be removed from its swivel base and taken to a surface plate, drill press or milling machine for continuous operations, since the base of the vise is accurately machined at right angles to the jaws.

The Winans' vise is made in standard sizes of jaws from 3 in. to 8½ in. and openings of 3½ in. to 12 in. The whole design is such that it will stand up under trying conditions and heavy work.

DRAFT RECORDING DEVICE

The economical operation of steam plants is made possible only by a thorough knowledge of operating conditions, and automatic recording devices of various sorts are a great aid in obtaining this knowledge. For example, one of the factors that affects boiler efficiency is the amount and uniformity of the draft, and an accurate knowledge of just how the draft varies from time to time during the day may explain the size of last month's coal bill.

It is also important that the right amount of air be furnished under the grates, and for the purpose of recording such gas pressures, the Bacharach Industrial Instrument Company, Pittsburgh, Pa., has manufactured various types of "Hydro" pressure recorders, one of which is illustrated.

Hydro Pressure Recorder

The instrument is simple in construction, its action depending on but one moving element, namely, a float in water. The float is in the form of an inverted bell communicating with the stack or gas main and the outside, the top of the bell being exposed to atmospheric pressure. The difference in pressure then between the stack and the air is measured by the vertical position of the bell and transmitted to a recording device by a rigidly connected pen. The recording chart is carefully calibrated and attached to a drum which revolves once in 24 hours by a clock arrangement. The re-

sult is a continuous and permanent record of draft pressure and variation.

An important advantage of the "Hydro" pressure recorder lies in the fact that it has no lever, pinion, stuffing box, etc., to wear out and cause inaccurate readings. It is durable, being made of non-corrosive metals and does not require careful leveling to give accurate results.

"Hydro" pressure indicators are built by the same company and differ from the recorders only in the substitution of a simple indicating mechanism for the recording device.

GLASS LUBRICATING CUP

A new lubricating cup for air compressor air cylinders has been patented by E. F. Glass, 1212 Third avenue, Altoona, Pa. As shown in the illustration, the body of this cup is a malleable iron casting threaded on a brass stud, the outer end of which has a ⅜ in. pipe thread to fit the standard air cylinder oil cup hole. A brass stem with a shoulder at the top, and a ⅛-in. hole running through it is screwed into the top of the stud. There are four 1/16-in. holes drilled through the top of the stem under the collar, and the wicking shown is made of .03-in. woven copper wire. The filling hole in the top of the cup is covered by a cap.

In operation, the cup is filled with oil and the cap screwed tightly on. Due to capillary attraction, oil feeds up the wire wicking to the four holes in the top of the stem, and on the

Glass Patent Lubricating Cup

expansion stroke of the compressor this oil is drawn through the hole, and down the stem into the cylinder. The amount of oil may be varied by changing the number of strands in the wicking.

The cylinder lubrication obtained by this method is complete, and results in increased compressor efficiency, and a material reduction in the wear of packing rings, cylinder and piston rod. Further advantages of the Glass lubricating cup are its simplicity and the lack of all regulating screws, valves and small ports to be obstructed by dirt. One filling of the cup will last 18 hours, with the compressor in continuous operation, and as the cup works automatically, no attention is required in the meantime. The cup can be used on any design of air compressor or internal combustion engine. It has given satisfactory results in actual test on one of the large eastern railroads.

PRESSURE GOVERNOR FOR GAS AND LIQUID SYSTEMS

In many power installations where air, other gases or liquids must be maintained under pressure, the demand has arisen for an automatic method of control.

As a result the General Electric Company has developed a new pressure governor to control standard self-starters for motor-operated pumps and compressors. The governor maintains a pressure between predetermined limits on any gas or liquid systems that will not corrode the Bourdon tube.

This governor is called the CR 2922 and can be used on

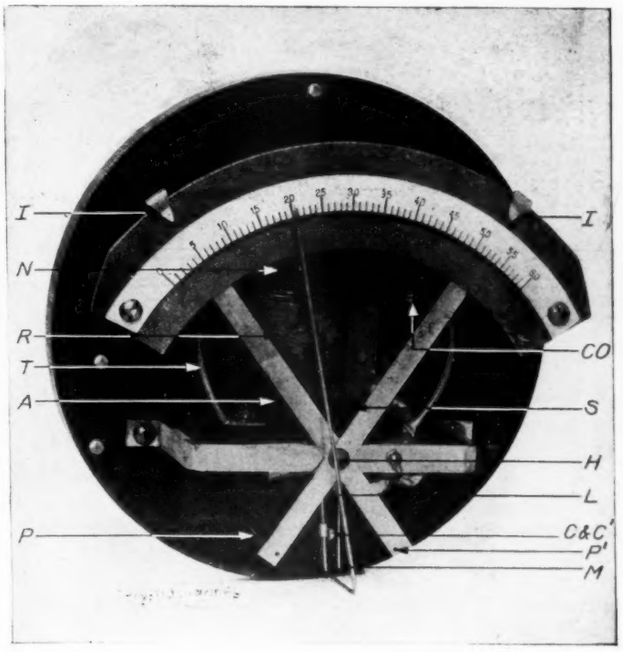


Fig. 1—Internal Mechanism for a Pressure Governor

any standard A.C. or D.C. circuit. It is rated for pressures of 80, 100, 160, 300, or 500 lb. and operates within settings of from 3 to 12 lb between high and low pressures. Governors for higher pressures can be supplied if desired.

The governor consists of a Bourdon tube, an indicating needle, a graduated pressure scale, adjustable high and low pressure stops to determine the desired pressure range and a relay which actuates the contacts in the control circuit of the self-starter, all enclosed within a dustproof case, easily opened for inspection.

Action of the governor is dependent on the Bourdon tube, which should be connected to an independent discharge pipe from the pressure tank. The free end of the tube *T*, Fig. 1, is mechanically connected to the indicator needle *N*, moving it over the scale as changes of pressure affect the tube.

After the settings for the pressure range have been made, the governor will automatically maintain pressure within those limits. Assuming that the pressure is at the low value, as indicated by the left hand indicator *I*, the contact *C* on the needle *N*, completes the circuit through the contact *C'* on

the movable arm *M*, which at the low pressure point rests against the stop *P'*. When this contact is made, the circuit is completed through the relay coil *R*, causing the armature *A* to close. Attached to this is the contact *CO* which upon closing completes the control circuit to the self-starter, causing the motor to start.

The armature is also attached to the spring *S* which holds the contact *C'* firmly against *C* until contact is broken at *P*. As the pressure increases, the needle pointer moves to the right, but its lower part, to which the contact *C* is attached, moves to the left and is followed by the movable arm *M*. When the high pressure point is reached, the movable arm is prevented from traveling further by stop *P* and the needle continues its course, breaking the circuit by separating contacts *C* and *C'*. The instant the circuit is broken, the relay *R* is de-energized, its armature falls, releasing the tension of the spring *S*, and because the movable arm *M* is counterweighted, it returns to the stop post *P'*.

Fig. 2—Pressure Governor Complete

When the pressure is decreased to the minimum value, the contact *C* again completes the relay coil circuit by engaging contact *C'* and the cycle of operation is repeated.

The case is tapped and drilled at the bottom for the pressure pipe and electrical conduit connections.

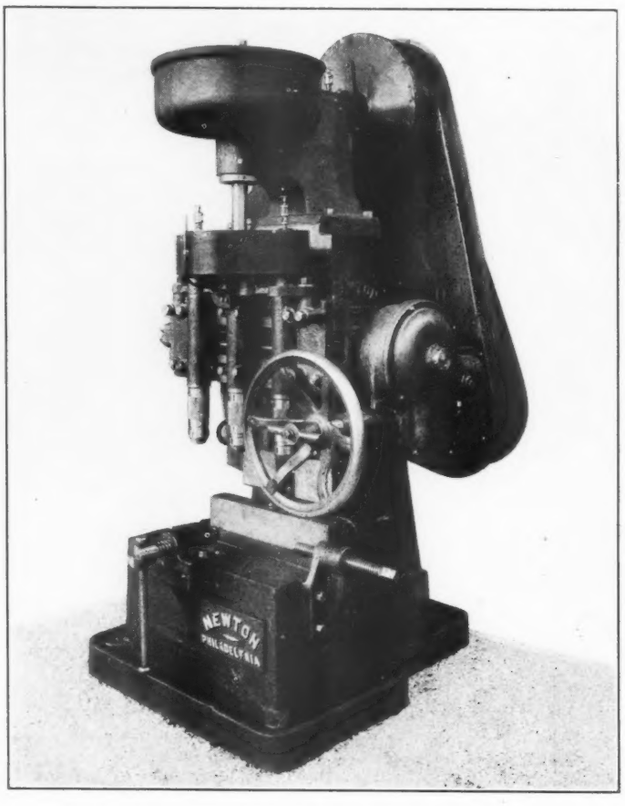
NEWTON RAIL DRILLING MACHINE

A new design of multiple spindle rail drilling machine has been brought out by the Newton Machine Tool Works, Inc., Twenty-third and Vine streets, Philadelphia, Pa. This machine is intended to be used in the rapid and simultaneous drilling of the three or four holes required in the ends of girder and other rails.

Referring to the illustration, the three spindles shown operate separately and are readily removed from the cross rail when desired. The spindle speed for the heavy drilling of main holes is 125 r.p.m. The work table is fitted with a slot in the top surface and an adjustable blocking arrangement to hold the rails in position while being drilled. The two outside spindles are adjustable separately and with regard to the table by means of hand operated screws so that drilled holes may be located wherever desired. All the important driving bearings are bronze bushed. All spindles, spindle gears and rack pinions are made of nickel steel. All gears are fully covered and a guard is placed around the motor belt. Pump piping and attachments for lubrication are included in the equipment.

The motor is mounted on a bracket on the left hand side of the machine and connected by belt directly to the main driving pulley on the back of the upright. The drive is then transmitted through bevel gears and spur gears to the spindles at the top of the saddle. The saddle is counterweighted and has vertical feed and hand adjustment. Two changes of feed are available vertically: .04 in. and .007 in. per revolution of the spindle.

The driving pulley is 26 in. in diameter and has a 5/8-in. face. The table is equipped with an adjustable back plate, a clamping screw and a reversing end slot. All three spindles are mounted on the one saddle and, therefore, feed in unison, and this particular design is equipped with a special holding chuck for driving drills of special rail design. The base of the machine is surrounded by an oil pan and the lubrication tank is in the base of the machine from which the lubricant is returned by pump piping and attachment to the point of cutting. The following are the general dimensions of the machine:



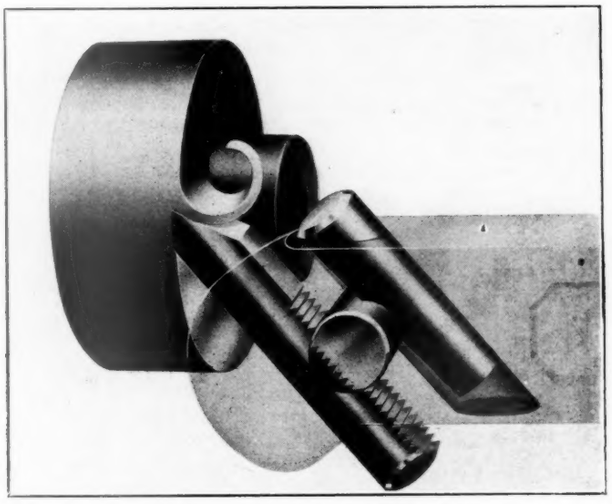
Newton Three Spindle Rail Drilling Machine.

Diameter of each spindle	1⅞ in.
Minimum distance between spindle centers	3½ in.
Maximum distance between spindle centers	9 in.
Maximum distance top of table to end of spindles	19½ in.
Size of work table	16 by 30 in.

CONDITION OF RUSSIAN RAILWAYS.—At a sitting of the Executive of Labor in Moscow, Commissary Shliapnikoff reported on the condition of the railways and the factories of Petrograd. The works and factories, he said, are now in such a state that it will require over three years to bring them to order. The report on the railways shows a state of things beyond all exaggeration. Full and complete disorganization exists among the employees at the stations and at the works. Production has greatly fallen off.—*Railway Gazette, London.*

INSERTED CUTTER TOOLS

The turning, facing and planing tool illustrated is an example of the line of positive lock inserted cutter tools manufactured by the Lovejoy Tool Company, Inc., Springfield, Vt. This company has not attempted to develop a universal holder having adjustment to cover all positions that might be required for tool making and which, therefore, embodies weaknesses unavoidable in a tool of that nature, but the intention has been to design a line of production tools closely approaching the solid forged tool in respect to rigidity, unnecessary overhang and objectionable projections. In this way, and by the satisfactory manufacture of inserted cutter tools, the advantages of a solid forged tool are combined with the economy of the inserted cutter type. There is no



Lovejoy Positive Lock, Inserted Cutter, Turning Tool

waste of expensive high speed steel, which in the solid tool performs no other function than to support the cutting edge. The advantages over tools with welded tips are the smaller chance of breaking and the adjustment of the cutting edge as the tool wears and is ground away.

The Lovejoy tools have a positive lock. In the tool illustrated the tool thrust is taken on the locking key, which in turn takes its seat on the solid metal of the holder. The tapered locking wedge only serves to bind the cutter in position, making it virtually a part of the holder which cannot slip or loosen even under heavy intermittent cuts. The cutter is capable of height adjustment as it becomes worn, thus giving each cutter a life equal to three or four solid or welded tools of the same shank size. New cutters may be obtained at comparatively low cost, there being an almost unlimited life to the holder, which is heat treated and capable of withstanding the heavy strains incident to present day feeds and speeds.

The cutters are high speed steel and are heat treated according to standard practice. They are interchangeable in the respective holders, being made to accurate gages. The position of the cutter relative to the work is always important and the Lovejoy tools are designed to have the end thrust come as nearly as possible against the cutting strains.

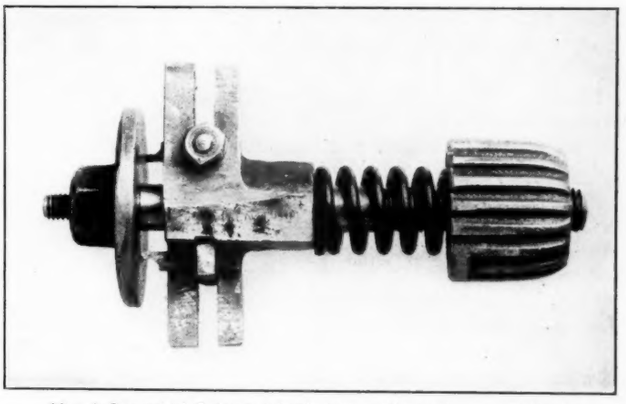
While the nature of boring work does not permit of the relatively ideal conditions for cutter positions afforded in turning and facing, the cutter is so supported in the holder as to receive largely an end thrust and a natural top rake. The grinding is done entirely on the end, and the cutter is locked in its holder with total absence of protruding set screw heads, thereby giving unobstructed chip room in holes only slightly larger than the holder itself. This permits the use of a larger tool than is usually possible in the inserted cutter type and again approaches the solid forged tool in rigidity.

The Lovejoy inserted cutter tools include right and left turning, facing and planing tools, boring bars, back facing bars and shaper and planer tools. Patented end milling cutters are made to order only.

JIFFY ADJUSTABLE CUTTER

In cutting large circular holes it is still common practice to drill out part of the material around the circumference and chip out the remainder. This method is laborious and the results produced are poor. Realizing the field for a tool which would expeditiously do such work, the firm of Koch & Sandidge, Chicago, has placed on the market the Jiffy adjustable cutter. This tool is adapted for cutting holes from 1¼ in. to 6 in. in diameter. With standard knives it will cut through 3/16-in. steel. Special knives can be supplied for cutting through ½-in. steel and also for cutting other materials such as slate, marble and fibre up to a thickness of 1 in.

The Jiffy cutter, as shown in the illustration, consists of a swing chuck of cast steel with two adjustable knives, mounted on a central stud and fed by a spring and hand nut. The knives are rotated by a special ratchet wrench applied to the chuck. In using the device a ⅜-in. pilot hole is drilled first and if the material is thin a flange nut is put on the opposite side of the sheet so that the stud may be placed through the pilot hole and screwed onto the flange



Hand-Operated Cutter Adapted to a Wide Range of Work

nut. In the case of heavy material, the pilot hole can be tapped with the standard thread and the stud set into it, thus eliminating the use of the flange nut where it might be difficult to get back of the material to place the nut in position.

Outside of the many ordinary applications such as cutting holes in distribution cabinets, conduit cut-out boxes, boilers, tanks, etc., there are many special applications, as for instance, cutting holes in heavy structural steel members and in awkward shaped castings which cannot readily be drilled by machine. Special washers which are generally costly to make and difficult to get can be quickly cut out with little effort by setting one of the knives at the inner diameter of the washer and the other at the outer diameter.

CUTTING POINTS FOR GRINDING WHEELS.—The number of cutting points on a grinding wheel is a matter of considerable controversy among theorists. But the best English authority gives for a wheel of 60 grain at 6,000 ft. per minute and one inch wide face a total of about eighty million cutting points per minute.—*The Engineer, London.*

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THE RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and of the Audit Bureau of Circulations (A. B. C.)

A fire at Napoleon, Ohio, on July 4, destroyed the roundhouse of the Detroit, Toledo & Ironton, together with four freight cars, and damaged ten locomotives; loss $50,000.

The southern regional director has issued a circular letter asking the railroads to submit promptly their recommendations as to the new locomotives each line will require for the year 1919.

President Wilson, by executive order, has suspended the provisions of the eight-hour law as applying to mechanics and laborers on contracts in connection with the construction and maintenance of the Alaskan Railroad.

The machine shop of the Texas & Pacific at Marshall, Tex., was destroyed by fire on June 9; estimated loss, including machines, patterns and valuation records, $300,000. The boiler shop and the erecting shop were slightly damaged.

V. R. Hawthorne, acting secretary of the Master Car Builders' Association and the American Railway Master Mechanics' Association, has transferred his office from 906 Karpen building to 746 Transportation building, Chicago.

Fifty retired employees of the Pennsylvania Railroad at Sunbury, Pa., were notified recently that places were open for them if they wished to return to work, and provided they should pass necessary physical tests. Many of these men are mechanics. They were told that in going to work now they would not disturb their relations to the company as pensioners.

Employees of the Pennsylvania Railroad in military or naval service, including those from lines both east and west of Pittsburgh, now number 16,407. This is shown by reports just completed for the purpose of revising the figures on the service flag which hangs in Broad street station, Philadelphia. When the flag was first hung, March 20, 1918, the single blue star in the center contained the number 11,769, showing an increase of 4,638.

In conjunction with its preparation for taking over the recruiting and supplying of common labor for war industries on August 1, the United States Employment Service is taking comprehensive measures to relieve the shortage of skilled workers, particularly machinists, which is handicapping the output of war materials and is little less serious than the common labor shortage. While the ban against private labor recruiting for war work for the present applies only to unskilled labor, it will eventually include skilled workers, such centralized skilled labor mobilization to be carried out through the common labor recruiting and placing machinery now being completed in each state by the federal employment service.

The women employed on the Pennsylvania Railroad now number 10,248, or 1,481 more than on June 1. Women are working in 69 classified occupations on that road. There are 6 working on car repairs, 74 at cleaning locomotives, 4 as locomotive despatchers, 29 as draftswomen, 1 is a coal inspector, 595 as laborers, 234 are messengers and assistant messengers, 9 are drawbridge attendants, 38 work as freight truckers, 1 is a trackwoman and 92 are employed as crossing watchwomen. Many other kinds of work are shown in the list, including 132 signalwomen and assistants.

As a result of a number of conferences of the United States fuel administrators and their committees, plans have been made for extending the program of coal saving in power plants to all states east of the Mississippi, and including Louisiana, Missouri and Minnesota. An administrative engineer will be appointed for each of the states in the area mentioned, who will work under the supervision of the present Federal administrator. No separate or new organization is contemplated, but sufficient addition to the working force in each state will be made to insure efficient execution of the new function. Questionnaires are being sent to owners of every power plant in each district and personal inspection will be made of all plants. They will be classified and rated, based upon the thoroughness with which owners conform to recommendations. Responsibility of rating plants will fall upon the administrative engineer in each state and the state fuel administrator in his judgment may entirely or partially shut off the supply of coal to any needlessly wasteful plant in his territory.

Fuel Conservation Section Organization Completed

The Fuel Conservation Section of the Division of Operation has now completed its organization to conform with the new regions. Its members are as follows: Eugene McAuliffe, manager; Major E. C. Schmidt, assistant to manager; Robert Collett, assistant manager, Eastern Region; Howard C. Woodbridge, supervisor, Allegheny Region; Harry Clewer, supervisor, Pocahontas Region; Bernard J. Feeney, supervisor, Southern Region; Frank P. Roesch, supervisor, Northwestern Region; Leslie R. Pyle, supervisor, Central Western

Region, and J. W. Hardy, supervisor, Southwestern Region. The section's head office is 629 Southern Railway building, Washington, and there is also an office in the Union Electric building, St. Louis, Mo.

New Western Purchasing Committees

The Western Regional Purchasing Committee has been dissolved and replaced by three separate committees, one for each of the three regions which formerly constituted the Western Region. The committees appointed are as follows:

Southwestern Region.—The headquarters of this committee are in St. Louis, Mo. It is composed of Charles A. Howe, general purchasing agent of the Missouri Pacific, St. Louis, Mo., chairman, and J. L. Cowan, purchasing agent, San Antonio & Aransas Pass, San Antonio, Tex.

Northwestern Region.—Headquarters are in Chicago and the chairman is L. S. Carroll, general purchasing agent of the Chicago & North Western, Chicago. F. A. Bushnell, purchasing agent of the Great Northern at St. Paul, Minn., is the other member of this committee.

Central Western Region.—L. N. Hopkins, purchasing agent of the Chicago, Burlington & Quincy at Chicago, is chairman of the Central Western Region, headquarters being in Chicago, and M. J. Collins, general purchasing agent of the Atchison, Topeka & Santa Fe at Chicago, is the other member.

All instructions and circulars heretofore issued by the Western Regional Purchasing Committee will remain in effect until further notice.

Federal Supervisors of Equipment

A number of the district inspectors of the Interstate Commerce Commission's Bureau of Locomotive Inspection have been transferred to the Locomotive Section of the Railroad Administration under the direction of Frank McManamy, whose title has recently been changed from manager, Locomotive Section, to assistant director, mechanical department of the Division of Operation, and have been appointed supervisors of equipment. These supervisors of equipment travel from road to road on orders from the Washington office, checking up the work of railroad shops engaged on the repair of locomotives and cars to see whether the shops are adequately equipped for their work, whether the work is being properly performed and whether the proper output is being obtained. A considerable portion of their time has been taken up recently in efforts to prevent strikes among the shop employees.

The list of supervisors of equipment who have been engaged in this work since some time in March is as follows: John G. Adair, Joe Beene, Harvey Boltwood, George N. DeGuire, George E. Dougherty, John M. Hall, John P. Kane, William Martin, John McManamy, Charles J. Scudder, John Wintersteen, and R. H. Collins, assistant supervisor of equipment.

Committee on Standards for Locomotives and Cars

A permanent committee on standards for locomotives and cars has been created by the Railroad Administration to succeed the car and locomotive standardization committee, which has had charge of the development of the designs for the standard cars and locomotives recently ordered by the Railroad Administration. The new committee will have the function of following up the standardization plans for the purpose of recommending any changes which may be found necessary in the standards already adopted or of developing additional standards. Forms have been prepared on which a record will be kept of the performance of the standard cars and locomotives for the purpose of recording any failures or any defects which may be developed in operation so that the records may be available when any additional orders for equipment are to be placed. The members of the committee, are as follows: Frank McManamy, assistant director, mechanical department of the division of operation, chairman; H. T. Bentley, Chicago & North Western; H. Bartlett, Boston & Maine; J. T. Carroll, Baltimore & Ohio; C. E. Fuller, Union Pacific; F. F. Gaines, Central of Georgia; A. W. Gibbs, Pennsylvania Railroad, eastern lines; H. L. Ingersoll, New York Central; J. E. O'Brien, Missouri Pacific; John Purcell, Atchison, Topeka & Santa Fe; F. P. Pfahler, mechanical engineer, locomotive section, Railroad Administration; J. W. Small, Seaboard Air Line; J. J. Tatum, Railroad Administration; and W. H. Wilson, Northern Pacific. E. A. Woodworth, who was assistant to Mr. Bentley as mechanical assistant in the division of operation, has been appointed secretary of the committee, which held a meeting at Washington on July 16, and thereafter will hold monthly meetings on the third Tuesday of each month.

Changes in M. C. B. Rules

The Master Car Builders' Association has issued Circular No. 1, dated June 22, stating as follows:

In view of the present abnormal conditions as to the material situation in this country and to encourage and facilitate repairs to cars, the following additions and amendments are made to the 1917 Code of the Rules of Interchange, all to become effective July 1, 1918.

Rule 86. New paragraph. M. C. B. standard 60,000 lb. capacity axle, with wheel seat less than the condemning limit for such axle, but above the condemning limit for non-M. C. B. standard axle, may be used until October 1, 1920, to replace M. C. B. standard 60,000 lb. capacity axle with wheel seat less than the condemning limit for such axle, but above the condemning limit for non-M. C. B. standard axle. (This paragraph abrogates the first interpretation shown under Rule 86, page 109.)

Rule 87. New paragraph. In order that repairs to cars may be expedited as fully as possible, foreign or private line cars may be repaired by the handling line by using material from their own stock instead of ordering material from car owner, as prescribed by Rule 122, in which event the repairing line is absolved from all responsibility for the cost of standardizing repairs thus made.

When wrong repairs are made, using materials which the repairing line should carry in stock, as prescribed by Rule 122, defect card should be issued to cover both labor and material. (This provision supersedes the interpretations under Rule 122 in Circular No. 15, dated October 31, 1917, and Circular No. 19, dated December 20, 1917, and is also to be considered as an exception to Rule 13.)

Further Details of the Standard Car and Locomotive Orders

The orders for specialties originally placed for the order of 1,025 locomotives have been extended proportionally for 390 ordered later. Of the latter order, which included 130 light Mikado locomotives from the American Locomotive Company, 50 have been changed to the heavy Mikado type. These are to be delivered to the Chicago, Milwaukee & St. Paul, which desired the change. Fifteen additional locomotives have been ordered from the Lima Locomotive Corporation.

The Central Advisory Purchasing Committee, of the Railroad Administration, has awarded the orders for brick arches for the 1,415 locomotives recently ordered, to the American Arch Company.

The three-point suspension and supports for brakebeams for the locomotives and the 100,000 freight cars have been ordered from the Chicago Railway Equipment Company.

Orders for headlight cases for the United States standard

locomotives have been placed as follows: 765, Schroeder Headlight & Generator Company; 500, Handlon & Buch; 500, Adams & Westlake.

Water gage cocks for the 1,415 standard locomotives have been ordered from the Nathan Manufacturing Company. Superheaters for the locomotives will be built by the locomotive builders on a royalty basis. The orders for all of the specialties for both the cars and the locomotives have now been placed.

The allotment of orders for the journal boxes for the government standard freight cars, as announced last month, has been changed. Journal boxes for 4,000 cars have been ordered from McCord & Co., and the order from the Haskell & Barker Car Company has been reduced from 8,000 to 6,000. A typographical error in last month's issue gave orders for journal boxes for 32,500 of the standard cars to the Union Spring & Manufacturing Company. This should have been given as 2,500 cars only.

MEETINGS AND CONVENTIONS

American Railway Tool Foremen's Association. — The executive committees of the American Railway Tool Foremen's Association and the Supply Association at a meeting held in Chicago on March 16, 1918, unanimously moved that the 1918 convention be postponed and the Year Book not published on account of the war.

Traveling Engineers' Association.—In connection with the annual meeting of the Traveling Engineers' Association to be held at the Hotel Sherman, Chicago, September 10 to 13, the Railway Equipment Manufacturers will have an exhibit. Applications for space are being sent out this week by C. W. Floyd Coffin, of the Franklin Railway Supply Company, 30 Church street, New York, who is secretary of the supply men's body. In his letter to the supply men, Mr. Coffin says: "The Traveling Engineers' Association expects its convention this year to be the largest in attendance it has ever held, and I believe it is equally important that the various supply companies will be well represented at this time, as this is the first opportunity afforded them to present their material to the many representatives of the United States Railroad Administration who are sure to be in attendance."

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

Air Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—O. E. Schlink, 485 W. Fifth St., Peru, Ind.

American Railway Master Mechanics' Association.—V. R. Hawthorne, 746 Transportation Bldg., Chicago.

American Railway Tool Foremen's Association.—R. D. Fletcher, Belt Railway, Chicago.

American Society for Testing Materials.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

Car Foremen's Association of Chicago.—Aaron Kline, 841 Lawlor Ave., Chicago. Second Monday in month, except June, July and August, Hotel Morrison, Chicago.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. R. McMunn, New York Central, Albany, N. Y.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, C. H. & D., Lima, Ohio.

International Railway Fuel Association.—J. G. Crawford, 542 W. Jackson Blvd., Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash, Winona, Minn.

Master Boilermakers' Association.—Harry D. Vought, 95 Liberty St., New York.

Master Car Builders' Association.—V. R. Hawthorne, 746 Transportation Bldg., Chicago.

Master Car and Locomotive Painters' Association of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass.

Niagara Frontier Car Men's Association.—George A. J. Hochgrebe, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.

Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio. Next meeting, September 10, 1918, Chicago.

PERSONAL MENTION

FEDERAL ADMINISTRATION APPOINTMENTS

Hiram W. Belnap, who was recently appointed manager of the safety section of the Division of Operation, United States Railroad Administration, resigned his position as chief of the Bureau of Safety of the Interstate Commerce Commission on July 1, to devote his entire time to the work of the safety section. Mr. Belnap will supervise the building up of an effective safety organization on all of the railroads under federal control. He had been with the Interstate Commerce Commission for 15 years, for seven years as chief of the Bureau of Safety, and for the eight preceding years as inspector of safety appliances.

C. H. Bilty, mechanical engineer of the Chicago, Milwaukee & St. Paul, with office at Milwaukee, Wis., has been appointed mechanical engineer on the staff of the regional director of Northwestern railroads, with office at Chicago, succeeding W. R. Wood.

J. T. Carroll has been appointed mechanical assistant to Charles H. Markham, regional director of the Allegheny region, United States Railroad Administration. Mr. Carroll was assistant general superintendent motive power of the Baltimore & Ohio, at Baltimore, Md.

Robert Collett, who was fuel supervisor and superintendent of locomotive performance of the Frisco Lines previous to 1914, and since that time assistant manager of the railroad department of the Pierce Oil Corporation, has been appointed assistant manager of the Fuel Conservation section of the United States Railroad Administration, with supervision over the Eastern region, and headquarters at New York.

C. S. Goldborough, assistant to president of the Erie, at New York, has been appointed assistant to the federal manager with jurisdiction over the purchasing and stores department, and will perform other duties assigned to him.

O. H. Wood, assistant purchasing agent of the Great Northern at Seattle, Wash., has been appointed special representative of the Central Advisory Purchasing Committee of the Railroad Administration, with headquarters in the same city. He will co-operate with that committee and assist in procuring railroad requirements of fir lumber.

GENERAL

W. Alexander, superintendent motive power of the Chicago, Milwaukee & St. Paul lines east of Mobridge, S. D., has resigned to enter the motor service department of the war department.

R. W. Anderson, division master mechanic of the Chicago, Milwaukee & St. Paul, at Miles City, Mont., has been promoted to assistant superintendent motive power of the middle district, with headquarters at Milwaukee shops, Milwaukee, Wis., succeeding A. N. Lucas.

E. J. Brennan, general master mechanic of the Baltimore & Ohio at Pittsburgh, Pa., has been appointed superintendent of motive power of the Chicago, Milwaukee & St. Paul lines east of Mobridge, S. D., with headquarters at Milwaukee, Wis., succeeding W. Alexander.

F. H. Clark, general superintendent of motive power of the Baltimore & Ohio, has been appointed general superintendent, maintenance of equipment, of the Baltimore & Ohio (eastern lines and New York terminals), the Western

Maryland, the Cumberland Valley, the Cumberland & Pennsylvania, and the Ccal & Coke, with headquarters at Baltimore, Md.

H. K. FOX, engineer of tests of the Chicago, Milwaukee & St. Paul, has been appointed mechanical engineer, with headquarters at Chicago, succeeding C. H. Bilty.

GEORGE P. KEMPF, master mechanic of the Dubuque division of the Chicago, Milwaukee & St. Paul, has been appointed engineer of tests, with headquarters at Milwaukee, Wis., succeeding H. K. Fox.

C. W. KINNEAR, assistant master mechanic on the Southwest system of the Pennsylvania Western Lines at Dennison, Ohio, has been appointed assistant engineer of motive power of the Central system, with headquarters at Toledo, Ohio, succeeding R. H. Flinn.

M. J. MCCARTHY, superintendent of motive power of the Baltimore & Ohio, with office at Cincinnati, Ohio, has been appointed superintendent maintenance of equipment of the western lines, with office at Cincinnati.

J. E. MECHLING, master mechanic on the St. Louis system of the Pennsylvania Western Lines, with headquarters at Terre Haute, Ind., has been promoted to superintendent motive power of the same system and with the same headquarters, succeeding W. C. Arp, retired.

L. B. MOREHEAD, shop inspector of the Chicago, Indianapolis & Louisville, has been appointed mechanical engineer, with headquarters at Lafayette, Ind., succeeding K. J. Lamcool, who has entered military service in the Quartermasters department.

A. N. OSTBERG, mechanical inspector of the Chicago, Burlington & Quincy, with headquarters at Chicago, has been appointed mechanical engineer for valuation, with the same headquarters, succeeding W. H. Davis, who has gone into the department of inspection and tests of the Railroad Administration at Washington, as office engineer.

H. A. SCHNITZ has been appointed inspector of tonnage rating of the Chicago, Rock Island & Pacific, succeeding C. M. Rogers, promoted.

J. F. SHEAHAN, superintendent of motive power of the Atlanta, Birmingham & Atlantic, continues under the United States Railroad Administration in the same position on that road, and is also superintendent motive power of the Georgia Railroad, the Atlanta & West Point, the Western Railway of Alabama, the Charleston & Western Carolina and the St. Louis-San Francisco lines east of the Mississippi river.

R. E. SMITH, general superintendent motive power of the Atlantic Coast Line, with office at Wilmington, N. C., has been appointed also general superintendent motive power of the Winston-Salem Southbound.

W. F. WALSH has been appointed assistant superintendent of motive power of the southern district of the Chicago, Milwaukee & St. Paul, with headquarters at Dubuque, Iowa, succeeding J. J. Connors, resigned. Mr. Walsh was traveling mechanical expert for the Galena Signal Oil Company, with headquarters in Chicago.

W. R. WOOD, formerly mechanical engineer of the Great Northern, and more recently mechanical engineer on the staff of the regional director of Northwestern railroads, has returned to the Great Northern as mechanical engineer at St. Paul.

O. C. WRIGHT, master mechanic on the Pennsylvania Western Lines, Southwest system, with headquarters at Logansport, Ind., has been promoted to superintendent on the Central system, with headquarters at Cambridge, Ohio, succeeding H. K. Brady.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

J. S. ALLEN, general foreman of the Canadian Pacific, at North Bay, Ont., has been appointed division master mechanic of the Sudbury division, succeeding C. A. Wheeler, promoted.

T. J. CLAYTON has been appointed master mechanic of the Texarkana & Fort Smith, with headquarters at Texarkana, Texas, succeeding A. D. Williams, resigned.

T. B. FARRINGTON, assistant master mechanic of the Pennsylvania Western Lines, Southwest system, with headquarters at Columbus, Ohio, has been promoted to master mechanic of the Michigan division, with headquarters at Logansport, Ind.

R. H. FLINN, assistant engineer of motive power of the Pennsylvania Western Lines, Central system, at Toledo, Ohio, has been appointed master mechanic on the St. Louis system, with headquarters at Terre Haute, Ind., succeeding J. E. Mechling.

J. C. GARDEN, master mechanic of the Grand Trunk at Battle Creek (Mich.) shops, has been appointed master mechanic of the Stratford (Ont.) shops in place of C. Kelso, assigned to other duties.

J. HAY has been appointed master mechanic of the Grand Trunk Lines in New England, with office at Portland, Me.

T. H. HOGAN has been appointed master mechanic of the Memphis line of the Louisville & Nashville, with headquarters at the Paris (Tenn.) shops, succeeding F. J. Monahan.

C. A. KOTHE, master mechanic of the Erie, with office at Port Jervis, N. Y., has been transferred as master mechanic to Brier Hill, Youngstown, Ohio.

F. V. MCDONNELL, master mechanic of the Pennsylvania Lines West of Pittsburgh, Northwest system, at Pittsburgh, Pa., has been appointed master mechanic, with office at Ft. Wayne, Ind., succeeding E. E. Griest, resigned.

B. YOUNG has been appointed acting assistant road foreman of engines for the Western division of the Pennsylvania Lines West.

G. J. MESSER, master mechanic of the Sioux City and Dakota division of the Chicago, Milwaukee & St. Paul, has been transferred to the Dubuque division, with headquarters at Dubuque, Iowa, in place of George P. Kempf.

F. J. MONAHAN, master mechanic of the Memphis line of the Louisville & Nashville, has been appointed master mechanic of the Birmingham division, with headquarters at the Boyles (Ala.) shops.

J. R. RIGGS, general foreman of locomotive repairs on the Pennsylvania Western Lines, St. Louis system, with headquarters at Logansport, Ind., has been appointed master mechanic on the Central system, Toledo division, with headquarters at Toledo, Ohio, succeeding G. E. Sisco, transferred.

A. J. VOGLER, general foreman at the passenger terminal of the Chicago, Burlington & Quincy at Western avenue, Chicago, has been promoted to the position of master mechanic of the Sioux City and Dakota division, with headquarters at Sioux City, Iowa, succeeding G. J. Messer.

CAR DEPARTMENT

GEORGE WINK, foreman of the Weehawken (N. J.) freight yards of the Erie, has been appointed joint car inspector at Weehawken.

SHOP AND ENGINEHOUSE

A. N. LUCAS, assistant superintendent motive power of the middle district of the Chicago, Milwaukee & St. Paul, has

been appointed shop superintendent, with jurisdiction over the locomotive department of the Milwaukee shops.

PURCHASING AND STOREKEEPING

HARVEY DE CAMP, purchasing agent of the Gulf & Ship Island, with office at Gulfport, Miss., has been appointed purchasing agent also of the Mississippi Central and the New Orleans Great Northern, with office at Hattiesburg, Miss.

F. H. FECHTIG, purchasing agent of the Atlantic Coast Line and the Charleston & Western Carolina, with office at Wilmington, N. C., has been appointed also purchasing agent of the Winston-Salem Southbound.

W. S. GALLOWAY, assistant purchasing agent of the Baltimore & Ohio, with office at Baltimore, Md., has been appointed purchasing agent for the western lines, with headquarters at Baltimore.

E. W. GRICE, assistant to president of the Chesapeake & Ohio, has been appointed manager of purchases, stores and safety, with headquarters at Richmond, Va.

L. M. JONES, assistant to the general manager of the Norfolk Southern, with office at Norfolk, Va., has been appointed purchasing agent.

A. S. MCKELLIGON, storekeeper of the Southern Pacific, at Sacramento, Cal., has been appointed general storekeeper, with headquarters at San Francisco, Cal., succeeding H. G. Cook, resigned.

RALPH P. MOORE, purchasing agent of the Duluth & Iron Range, with headquarters at Duluth, Minn., has had his jurisdiction extended over the Duluth, Missabe & Northern.

ROBERT B. PEGRAM, executive general agent of the Southern Railway, at Memphis, Tenn., has been appointed general purchasing agent of the Southern Railway System, the Alabama & Vicksburg, the Georgia, Southern & Florida, the Carolina, Clinchfield & Ohio and the Carolina, Clinchfield & Ohio of South Carolina, with headquarters at Washington, D. C. Mr. Baker was born on August 22, 1874, at Marion, Ala., and was educated in private schools at Memphis, Tenn. In July, 1890, he began railway work with the Southern Railway. In 1895 and 1896 he was chief clerk of the Memphis Freight Bureau, and later in 1896 served as chief clerk to the assistant general freight agent of the Illinois Central, at Memphis. In January, 1904, he was appointed soliciting freight agent of the Southern Railway, subsequently served as commercial agent at the same place, and later as chief clerk to the vice-president at St. Louis, Mo. In December, 1905, he was appointed assistant general freight agent at Nashville, Tenn., and in April, 1907, he was promoted to general freight agent at the same place, subsequently serving as general freight agent at Charleston, S. C. On May 1, 1910, he was appointed general agent, executive department, with office at Charleston, and since January, 1917, was executive general agent with office at Memphis until he received his recent appointment.

W. A. STARRITT, purchasing agent of the Carolina, Clinchfield & Ohio and the Carolina, Clinchfield & Ohio of South Carolina, at Johnson City, Tenn., has been appointed local purchasing agent, with headquarters at Johnson City.

M. W. STEVENS has been appointed purchasing agent and storekeeper of the Grand Trunk Lines in New England, with office at Portland, Me.

C. B. WILLIAMS, purchasing agent of the Central of New Jersey, at New York, has been appointed purchasing agent of that road, also of the Philadelphia & Reading, the New York & Long Branch, the Atlantic City and the Port Reading, with headquarters at Philadelphia, Pa.

COMMISSION APPOINTMENT

JOHN M. HALL, formerly district inspector of locomotive boilers for the Interstate Commerce Commission and recently supervisor of equipment in the locomotive section of the Railroad Administration, has been appointed assistant chief inspector of locomotive boilers of the Interstate Commerce Commission, succeeding A. G. Pack, promoted.

ALONZO G. PACK, assistant chief inspector of the Bureau of Locomotive Boiler Inspection, Interstate Commerce Commission, has been nominated by President Wilson chief inspector, succeeding Frank McManamy. Mr. Pack was born on July 22, 1865, at Princeton, W. Va. His first 15 years were spent on a farm, and in 1880 he entered the service of the Norfolk & Western on construction work. In 1882 he went to the Chesapeake & Ohio, as an apprentice in the boiler shop. He also served on that road as a brakeman. In 1887 he went to Denver, and worked for the Union Pacific and the Denver & Rio Grande, as locomotive fireman. In 1895 he became connected with the Colorado Midland as an engineman. In 1900 he went to the Colorado Springs & Cripple Creek, serving as locomotive engineman until 1911, when he was appointed district inspector of locomotive boilers of the Interstate Commerce Commission, with headquarters at Denver, Colo. In 1914 he was promoted to assistant chief inspector.

A. G. Pack.

WILFRED P. BORLAND has recently been promoted from assistant chief to chief of the Bureau of Safety of the Interstate Commerce Commission, succeeding H. W. Belnap. Mr. Borland has been in the service of the Interstate Commerce Commission for 16 years, having become identified with its safety appliance work when it was first established under the late secretary of the commission, E. A. Moseley. Mr. Borland entered railroad service in 1876 as a brakeman on the Flint & Pere Marquette, and in about a year became fireman. He was later fireman and engineman on this road, the Denver & Rio Grande, and the Northern Pacific, making a total of about 20 years in railroad service, which he left in 1896. He was then a stenographer at the Mare Island Navy Yard, and became connected with the Interstate Commerce Commission in 1902. He was for a number of years inspector clerk in the safety appliance department, and later was secretary of the Block Signal and Train Control Board. On February 5, 1914, he was appointed assistant chief inspector of safety appliances

W. P. Borland.

SUPPLY TRADE NOTES

James M. Hopkins, chairman of the Camel Company, Chicago, has accepted a position with the Priorities Committee of the War Industries Board. Mr. Hopkins will reside in Washington.

Lieut. J. G. Russell, of the Royal Flying Corps, formerly traveling inspector for the American Steel Foundries, with headquarters at Chicago, was killed in action on the Italian front, June 15.

John F. Kane, assistant secretary of the Pullman Company, was elected secretary at a meeting of the board of directors of that company, held on June 10, to succeed A. S. Weinsheimer, deceased. Mr. Kane is a native of Ingersoll, Ont. He received his early education in the schools of that city, following which he came to Chicago. On September 1, 1891, he entered the service of the Pullman Palace Car Company, now the Pullman Company, as a telegraph operator. In 1904 he was appointed paymaster with headquarters at Chicago, in which position he remained until 1913, at which time he was elected assistant secretary. He continued in that position until his recent election as secretary with headquarters at Chicago, as mentioned above.

J. F. Kane

The United States Metallic Packing Company, Philadelphia, Pa., announces that it no longer represents the Watertown Specialty Company for the sale of that company's automatic cylinder cock.

Frank C. Hasse, district superintendent of the Oxweld Railroad Service Company, with headquarters at Chicago, has been commissioned a captain in the quartermasters corps of the National Army.

The Lagonda Manufacturing Company of Springfield, Ohio, has moved its Kansas City office from 314 Dwight building to 306 Elmhurst building. F. H. Penberthy is in charge as district sales manager.

The Bird-Archer Company has moved its Chicago office from room 866 to room 1105 Peoples Gas building, to obtain larger space. This company has recently established a plant in Chicago and one at Cobourg, Ont.

The Austin Company, Cleveland, Ohio, has opened a new branch office at Chicago. This new office is the direct result of an increased volume of business from the middle west section. The location is 437 Peoples Gas building.

The Ralston Steel Car Company, Columbus, Ohio, has abolished its Chicago office in the Peoples Gas building. Ford S. Clark, who has been the representative at Chicago, has been appointed sales representative at Philadelphia, Pa.

L. C. Sprague, of the railroad department of the H. W. Johns-Manville Company, at New York, has been appointed special representative of the Chicago Pneumatic Tool Company in connection with the sale of pneumatic tools to railroads.

George A. Post, president of the Standard Coupler Company, New York, and honorary vice-president of the Railway Business Association, has been elected chairman of the Railroad Committee of the Chamber of Commerce of the United States.

The firm of Koch & Sandidge, with offices at 19 South Wells street, Chicago, was recently formed to handle the sales engineering work for the line of "Jiffy" cutting tools and similar products manufactured by the Universal Tool & Appliance Company, of Milwaukee, Wis.

Frank Lucas DeArmond, who for a number of years has been an officer of the Protectus Paint Company, Philadelphia, Pa., has severed his connection with that company for the duration of the war, having been appointed a captain in the quartermaster's corps, construction division.

The Baldwin Locomotive Works, according to an announcement made on July 9, is planning the immediate construction of a new plant at East Chicago, with an estimated cost of $5,000,000. Specifications for various buildings are now out calling for 12,000 tons of structural steel.

A. S. Goble, sales representative of the Baldwin Locomotive Works and the Standard Steel Works at Chicago, has been appointed southwestern district representative of the same companies at St. Louis, Mo., succeeding C. H. Peterson, who has been transferred to the Chicago office as western district representative.

Edward F. Carry, president of the Haskell & Barker Car Company, has resigned as director of operations of the Shipping Board to become chairman of the Port and Harbor Commission. He will be succeeded on the Shipping Board by J. H. Rosseter, of San Francisco, vice-president and general manager of the Pacific Mail Steamship Company.

Clinton C. Murphy, vice-president of the P. H. Murphy Company, and the Standard Railway Equipment Company, of Chicago, died on July 13, in that city. Mr. Murphy was born at Cumberland, Md., on June 5, 1875, and was educated at Smith Academy, St. Louis, Mo. After completing his education he entered the employ of the Cairo Short Line as a machinist apprentice. In 1898 he entered the railway supply business as a representative of the Murphy Roofing Company at St. Louis, following which he moved to Chicago, on his election as vice-president of the Standard Railway Equipment Company. In 1915 he organized and was made president of the Union Metal Products Company. He was also interested in the Imperial Appliance Company and the Pressed Steel Manufacturing Company, both of Chicago.

C. C. Murphy

At a directors' meeting of the Chicago Pneumatic Tool Company, held June 28, W. P. Pressinger, general manager of sales, with headquarters at Chicago, and W. H. Callan, manager of plants, with the same headquarters, were elected

vice-presidents. Mr. Pressinger's photograph and biography were published in the *Railway Mechanical Engineer* for June.

The Pittsburgh Testing Laboratory announces the removal, on July 1, from its temporary quarters in the B. F. Jones Law building to its new office and laboratory buildings at 612-620 Grant street, Pittsburgh, Pa. The laboratories will be larger and better equipped than those in the company's old quarters, the P. T. L. building at Seventh and Bedford avenues, which were turned over to the government April 1.

Robert Brown Carnahan, Jr., vice-president of the American Rolling Mill Company, Middletown, Ohio, was accidentally killed on June 22. He was educated at the University of Pittsburgh, graduating with the class of 1891. Upon the completion of the university work he became associated with the Dewees-Wood Company at McKeesport, Pa., where he was engaged in research work in connection with gold mine prospects. He remained with that concern until 1899, when he went with the Carnegie Steel Company at its Homestead works, where he was engaged in special work in connection with the manufacture of open hearth steel. In 1900 he entered the service of the American Mill Company as chief chemist and open hearth superintendent at what is now known as its Central works. Under Mr. Carnahan's direction the Armco American ingot iron was developed.

R. B. Carnahan, Jr.

The Quigley Furnace Specialties Company, Inc., has opened a branch office in Pittsburgh at 427 Oliver building, to handle the sale of powdered coal equipment and Hytempite furnace cement. The powdered coal engineering department will be in charge of L. V. Marso, formerly maintenance engineer of the A. M. Byers Company plant at Girard, Ohio, and the specialties department will be taken care of by J. L. Cummings, Jr., formerly connected with the sales department of the company at New York.

At a meeting of the board of directors on June 28, George W. Wildin was elected general manager of the Westinghouse Air Brake Company, succeeding A. L. Humphrey, resigned. Mr. Humphrey continues as ranking vice-president, and in that capacity will, as heretofore, have general direction of the company's operations in all departments and subsidiary organizations, Mr. Wildin reporting to him. A photograph and sketch of Mr. Wildin's career were published in the April *Railway Mechanical Engineer.*

The Barco Manufacturing Company, Chicago, has placed on the market a type of crosshead and shoe, invented by Charles D. Markel, chief construction inspector of locomotives in the Inspection and Test Section of the United States Railroad Administration. This device, which is known as the Barco crosshead and crosshead shoe, was described in the *Railway Mechanical Engineer,* issue of January, 1917, page 49. The company is prepared to furnish crossheads complete or to sell the shop rights to manufacture the device at the option of the railroads.

CATALOGUES

SHAY GEARED LOCOMOTIVES.—The Lima Locomotive Works, Lima, Ohio, has issued a circular illustrating the Shay geared type of locomotive and enumerating the advantages which they possess over other locomotives.

GRINDING WHEELS.—The National Safety Council, Chicago, has issued a loose-leaf pamphlet on grinding wheels, which describes safe practices with regard to the inspection, storage and mounting of wheels and the condition of machines, hoods and guards.

ELECTRIC METERS.—Bulletin No. 50 issued by the Economy Electric Devices Company, Chicago, illustrates and describes the Sangamo Economy electric meter and its application for regulating the power consumption of electric traction units. The advantage of proper acceleration and the savings to be effected thereby are clearly set forth.

VALVES AND FITTINGS.—A new catalogue of hydraulic valves and fittings has just been issued by the Hydraulic Press Manufacturing Company, Mt. Gilead, Ohio. The book is well written and illustrated, and presents in an attractive way the complete H-P-M line. Four general classes of hydraulic valves are shown; also different types of hydraulic fittings, such as accumulator controls, pressure gages, hydraulic valves, etc. Many of these devices are of improved design and are described for the first time in this catalogue. Copies may be obtained on request.

ELECTRIC WELDING.—A 6-in. by 9-in. 45-page manual entitled "Electric Welding" has been issued by the Wilson Welder & Metals Company, Inc., New York. This manual provides instructions covering the installation, care, operation and maintenance of Wilson electric welding equipment. Also, directions are given regarding the welding of various kinds of metal, the grade of welding wire to be used, the amount of current to employ, etc. Some interesting illustrations are given of the broken cylinders on the converted German steamships which were successfully repaired by the electric welding process.

THE BAKER LOCOMOTIVE VALVE GEAR.—Under this title a book of pocket size, bound in stiff paper covers, has been published by the Pilliod Company, 30 Church street, New York. This publication is a treatise on the Baker locomotive valve gear, which is completely described and illustrated, and for which a large amount of data is given in tabular form as to valve events, proportions of parts, etc. About one-half of the book is devoted to a description of the methods of setting the valves, each step in the explanation being accompanied with an example. Several pages are also devoted to the Sentinel low water alarm, which is manufactured by the Pilliod Company. For general distribution a price of 25 cents is quoted.

LIFTING JACKS.—Catalogue "F," recently issued by the Joyce-Cridland Company, Dayton, Ohio, contains descriptions, illustrations and prices of a complete line of lifting, pulling and pushing jacks. The hydraulic jacks include both inside and outside pump types with a wide range of capacity up to 200 tons. The line of geared screw jacks in capacities of 25 to 75 tons, include types suitable for both bridge and railroad shop work. The line also includes automatic geared jacks, automatic lever jacks, track jacks, telescope screw jacks, traversing bases for lifting jacks and a variety of jacks for special classes of service. Repair parts for the various jacks are illustrated and listed in convenient form for ordering.